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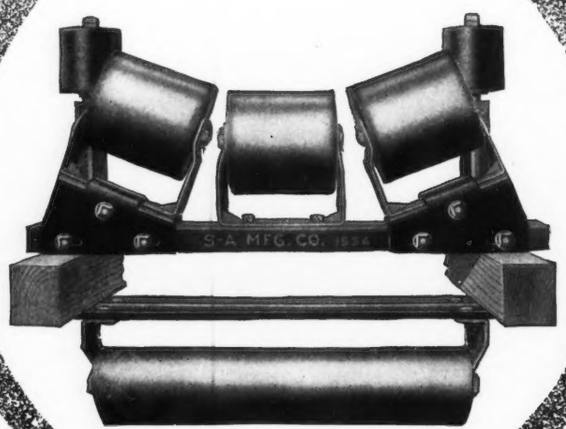

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Engineering and Mining Journal

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Mining in Southern Peru

By Francis Church Lincoln*

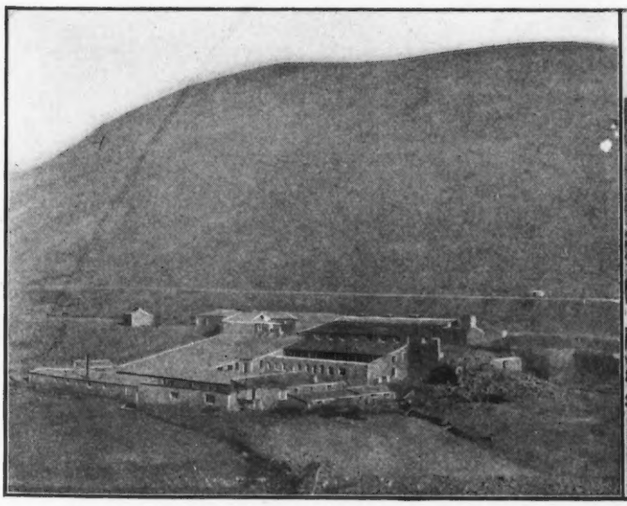
SYNOPSIS—Silver and copper are associated in the numerous deposits in the plateau region of southern Peru bordering upon Lake Titicaca. The district is an old one formerly worked by the Spaniards. Coal and limestone occur, facilitating local smelting. Low mining costs are possible because of the cheapness of labor. Three companies are active, and mines long abandoned are gradually being reopened. The same copper-bearing formations that are the source of the ore at the Bolivian camp of Corocoro are found in these parts.

The plateau region of southern Peru west of Lake Titicaca was the scene of extensive silver mining in the days of the ancient Spaniards, and the early histories of several of the mines mentioned in this article are found in Palma's "Tradiciones Peruanas." Within recent years the growth of the mining industry in this part of Peru has been slow, but there are now three large companies operating and its future development seems likely to be more rapid. These companies are the Sociedad Explotadora de Caylloma Consolidada, whose new 100-ton cyanide plant began operation on June 25 last; the Lampa Mining Co., Ltd., which has been operating a small copper smeltery at Santa Lucia in connection with its mines in that neighborhood for the past three years; and the San Antonio de Esquilache mine, which has recently installed an experimental cyanide plant. In addition to these, there are smaller companies in the region which make occasional shipments of ores.

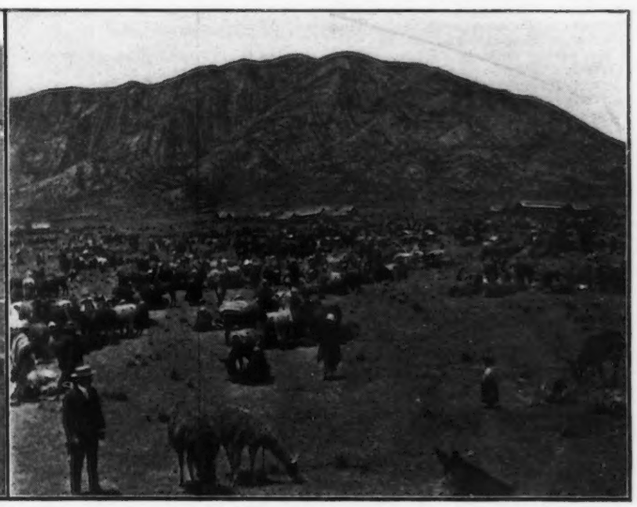
While the transportation facilities of the country leave much to be desired, southern Peru is fortunate in having the longest railroad in the country and in its accessibility from the neighboring republic of Bolivia. The Southern Railway of Peru is shown on the map, running from Mollendo on the Pacific to Arequipa, and thence across the Western Range of the Andes at Crucero Alto, 14,688 ft. high, to the port of Puno on Lake Titicaca. From Puno steamers run to various ports on the lake and on the Desaguadero River, especially to Guaqui in Bolivia, which is connected by rail with La Paz. The latter town has two railroads to the Chilean coast—one to Arica and the other to Antofagasta.

Lake Titicaca is 12,500 ft. above the sea, and the plateau upon which it rests rises still higher to the westward, bearing upon it numerous ranges of hills. These hills are rarely more than a thousand feet above the valleys, yet owing to the elevation of the plateau they frequently attain heights of 15,000 and even 16,000 feet. The topography is glacial, with rounded hills, cirques, long U-shaped valleys, and glacial lakes even near the summit of the divide, as indicated by the map.

The rocks of the region include Paleozoic shales and limestone, Mesozoic and Tertiary red and white sandstones and acid eruptives. Silver veins occur in the last-named and to a lesser degree in the Paleozoic limestones, while



CAYLLOMA CYANIDE PLANT, ONE OF THE LARGER OPERATIONS IN PERU



MESOZOIC SANDSTONES AT DESAGUADERO, SHOWING FOLDING AND EROSION

*Director, Mackay School of Mines, University of Nevada, Reno, Nev.

copper-bearing beds are found in the Tertiary sandstones. The silver veins usually contain a little gold and considerable chalcopyrite (less commonly chalcocite or tetrahedrite), galena, sphalerite and pyrite. Sometimes one sulphide will dominate or even exclude the others, but in general the sulphides of copper, lead, zinc and iron are present in roughly equal proportions forming a base ore that is difficult to treat. Similarly, the gangue includes barite, calcite, rhodonite, quartz and jasper, although some of these minerals may be lacking at times. At the surface are oxides, the rhodonite weathering to black manganese oxide. The silver veins were probably all formed about the same time by hot waters following the intrusion of the Tertiary eruptives. The copper ores in the Tertiary sandstone contain as a rule much smaller proportions of silver than the silver veins of the region and are remarkably free from other impurities, which would indicate that they were formed in a different manner from the silver veins, although, perhaps from the same source. The copper minerals observed were chalcocite, brochantite, native copper, cuprite, melaconite, azurite and malachite. The deposits seem to be confined to the white sandstone strata as at Corocoro, the Bolivian copper camp.

Table I shows the compositions of some of the ores. These have all been picked to a certain extent, and most of them contain zinc, though this has not been determined quantitatively.

TABLE I. ORES OF SOUTHERN PERU

Formation	Mine	Oz. Au	Oz. Ag	% Cu	% Pb	Ratio Oz. Ag to % Cu
Paleozoic	Berenguela	....	30.0	1.5	....	20
Paleozoic	Berenguela	....	5,109.0	49.8	....	100
Mesozoic	Tacasa	....	Trace	8.0	....	Very Low
Mesozoic	Caballero	....	14.0	7.0	....	2
Mesozoic	Virgen de Huanchaca	....	10.0	11.0	....	1
Tertiary	Caylloma	1.75	300.0	Trace	Trace	Very High
Tertiary	Vizcachani	....	80.0	40.0	....	2
Tertiary	Pocomoro	....	20.0	13.0	....	1½
Tertiary	Recompensa	0.06	20.3	7.8	....	3
Tertiary	Perseverancia	Trace	32.6	....	32.8	...
Tertiary	San Antonio de Esquilache	0.05	240.0	Trace	Trace	Very High
Tertiary	Plenty	0.07	42.2	9.9	23.0	4
Tertiary	Inagotable	....	48.0	17.0	16.0	3
Tertiary	Pataquena	Trace	361.6	13.7	....	26

These figures have been obtained from smeltery returns, statements made by engineers and assays made for the writer, and are believed to be fairly accurate and representative.

Sumbay is the shipping point for the Caylloma mine, which lies 35 leagues north. Originally operated by an English company, the mine was reorganized in 1906 as a Chilean company with head office in Valparaiso, under the name of Sociedad Explotadora de Caylloma Consolidada, but is still under English management. H. A. Barker is manager and Carl Fox assistant manager. The mine is said to have a number of parallel veins in porphyritic rock containing silver, mainly as polybasite, gold, galena, pyrite, quartz and rhodonite. One antimony vein was worked to a slight degree during the high price of antimony. The miners receive $2 per day, laborers $0.50, and women $0.30. Power is supplied by three hydro-electric plants. A Whitcomb gasoline engine is used inside the mine and steam engines on the seven-mile narrow-gage line connecting mine and mill. The character of the shipping ore may be seen from Table I. The milling ore is said to run 30 oz. of silver per ton.

About 10 miles north of Santa Lucia station the Mesozoic sandstones outcrop in the Tacasa district. There are at least three copper-bearing beds here, and the Lampa Mining Co. is working them on a small scale at two points nearly a mile apart. Between the Tacasa district and Santa Lucia this company has some small properties containing narrow silver veins in porphyritic rocks and including the Pocomoro and Vizcachani mines, whose ores are listed in Table I. The Lampa smeltery is about one mile from Santa Lucia station at the Limon Verde mine. This mine contains a number of silver veins in Paleozoic limestone and produced high-grade ore in the past, but is now shut down.

The Lampa smeltery is developing a coal-mining industry at Sumbay, following the example of the Cerro de Pasco Co. farther north. The coal outcrops on a hillside and has been attacked in a number of places. It is a poor anthracite containing much pyrite and having the following proximate analysis: Moisture and volatile matter, 10%; fixed carbon, 60%; ash, 30%. Were it not for the fact that the volatile matter is mainly sulphur and not hydrocarbons, the coal would not be an anthracite.

The Berenguela Mine of the Lampa Company

The principal mine of the Lampa Mining Co. is the Berenguela, which has produced some two-thirds of the tonnage smelted by the company during the past three years. This mine is situated about five miles east of Santa Lucia. There the Paleozoic limestone has been replaced by manganese oxides and quartz over an area about a mile long by 1000 ft. wide. This mineralized area extends from east to west across a range of hills forming steep bluffs where it reaches the valleys on either side of the range. At the east end of the property the manganese replacement has been smaller and that of quartz greater than at the west end, where the whole thousand feet is black with manganese oxide. At the east end there are alternating layers of black and white replaced limestone, the color depending upon the quantity of manganese.

COPPER-BEARING SANDSTONE, NEAR DESAGUADERO

In various parts of this mineralized area are irregular workings from which ore running 30 oz. silver and 1.5%

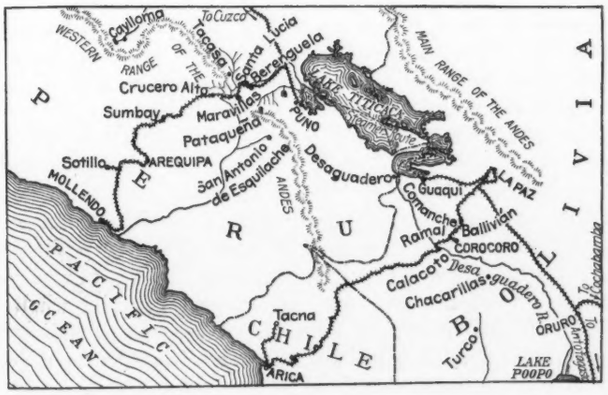
copper is taken and shipped by llama to the smeltery at Santa Lucia. A few tons of rich ore running 4000 oz. of silver and 45% copper have been produced from narrow stringers in the low-grade workings. A piece of this chalcocite ore analyzed for the writer gave the results shown in Table II. The silver appears to be associated with the quartz rather than the manganese oxide, since black ores and white ores are equally rich. The black ore is almost a commercial manganese ore, as may be seen from the analyses made by the smeltery.

TABLE II. ANALYSES OF BERENGUELA ORES

	West End Black Ore, %	East End Black Ore, %	East End White Ore %
SiO_2	22.10	26.00	29.50
FeO	5.40	9.00	4.90
MnO	42.20	33.00	5.40
CaO	10.50	11.00	30.00
Cu	1.50	1.00	1.80
CO_2, H_2O, S, etc. (by difference)	18.30	20.00	28.40
	100.00	100.00	100.00

Copper stains are rare and when they do occur usually indicate good silver values. The stains generally consist of the green basic sulphate, brochantite.

Aymara Indian labor is employed at the mine. Miners receive $0.70 per day, laborers $0.50 to $0.55, and women $0.20 to $0.25. While it takes several Indians



MAP SHOWING CAMPS IN THE REGION OF LAKE TITICACA

to accomplish the work performed by a single man in the United States, the wages are so low that labor costs are much lower. Even lower costs are obtained by contracting, which is employed whenever practicable. Indians are paid from 10 to 35c. per car of 800 lb. of ore delivered on the patio. Women receive 2c. per sack of 170 lb. for breaking the ore to sacking size. Tunnels are contracted for at $1 to $1.50 per ft. advance. The total cost of mining exclusive of overhead charges is estimated to be from $2 to $2.50 per ton. Llama freight to the smeltery is $1.

At Maravillas, the next station east of Santa Lucia, is the old mill of the British Maravillas Syndicate, which many years ago tried unsuccessfully to treat the ores of the Berenguela mine by amalgamation. A little south of the railroad are the Perseverancia lead-silver mine and the Recompensa copper-silver mine belonging to Frederick Grundy, who produces small amounts of shipping ore from them. Mr. Grundy also owns a pyrite mine in the same neighborhood, from which he makes regular shipments to the Lampa smeltery, which needs the pyrite for its sulphur content.

In the district about Puno, extending toward Santa Lucia on the west and toward San Antonio de Esquilache on the south, are many old Spanish mines. The Santa Teresa and Laycacota, are near town and were recently denounced by Sr. Leopoldo Lostaunau. These were big silver producers in the days of the *conquistadores,* but have not been reopened as yet. Sr. Lostaunau has, however, reopened one old mine in the San Antonio de Esquilache district, which he rechristened the Plenty, and has made a number of shipments from it. Similarly, Sr. J. M. Peñarietta has reopened the Inagotable mine, seven leagues from Puno and shipped several lots of ore. With the exception of the San Antonio de Esquilache mine, however, the Pataqueña mine shown on the map is the only one in the region which has produced regularly within recent years. This mine was equipped with a little mill and smeltery and appears to have been doing very well until the death of its late owner, Sr. Guinassi, six years ago, whose heirs have let the plant go to ruin and have not attempted to work the mine.

The San Antonio de Esquilache mine is situated 10 leagues southwest of Puno, as seen on the map. Until recently it exported about 20 tons of ore per month, containing 240 oz. of silver and ½ oz. of gold, but now the shipments have ceased while ore-testing is being conducted with an experimental cyanide plant. The mine is said to have numerous parallel lodes in porphyry averaging about three feet in width and containing, besides the gold and silver, galena, sphalerite and a very little chalcopyrite, in a gangue of calcite with a little quartz.

The District About Desaguadero

The Desaguadero River forms the boundary between Peru and Bolivia on the south side of Lake Titicaca, and the towns of Desaguadero, Peru, and Desaguadero, Bolivia, face each other down the river a little below its junction with the lake. The country rock here consists of Tertiary sandstones with alternating red and white strata which present a very peculiar appearance due to folding and erosion. Certain of the white sandstone strata are copper-bearing, the ore seeming to be closely associated with abundant plant remains. Fossil wood and leaves are in part composed of copper minerals, and the adjacent rock is also mineralized. Near Desaguadero, Peru, there are at least six such copper-bearing beds in close proximity, while some 10 miles south there are two beds separated by 20 ft. of barren strata.

Attention has already been called to the copper beds of the Tacasa district north of Santa Lucia and about 125 miles northwest of Desaguadero. At Desaguadero the copper belt passes into Bolivia, and copper-bearing sandstones outcrop near Guaqui, 20 miles east. Fifty miles to the southeast is the great Bolivian copper camp of Corocoro, where the ore occurs in the white strata of red and white Mesozoic sandstones just as in the localities noted. Still farther to the southeast, at Chacarillas and Turco in Bolivia, similar copper-bearing sandstones are said to occur. The distance from Tacasa to Turco is 240 miles, and it is quite probable that the copper belt extends beyond these places both northwest and southeast.

California Magnesite is purer than the Austrian, which carries 6 to 8% of iron, which means that it is better adapted to paper, tiling and cement than to refractory purposes, according to the United States Geological Survey. One Napa County property, however, has a product like the imported material. The Western Magnesite Co. states that it is mixing its product with 10% of steel furnace slag, thereby adapting it to metallurgical use.

The Amorphous Silica of Southern Illinois

By E. A. Holbrook*

SYNOPSIS—Mining of the silica deposits of southern Illinois and grinding the product for the market was carried on in a desultory sort of way for a number of years. Within the last few years, notably since the beginning of the European War, the industry has received tremendous impetus.

The flat glaciated prarie of the northern and central part of Illinois is underlain generally by the Carboniferous system of rocks which contains the extensive coal seams of the Middle West Coal Basin. On going south through Jackson or Williamson County, one passes the outcrops of the principal seams, dipping north. On roughly this same line the southern limit of the glaciated surface is passed. Immediately the topography changes. The flat prarie gives way to the decidedly hilly and rough unglaciated surface found in Union, Alexander and other southern counties of the state.

The principal silica deposits occur in Union and Alexander Counties. Running north and south through these

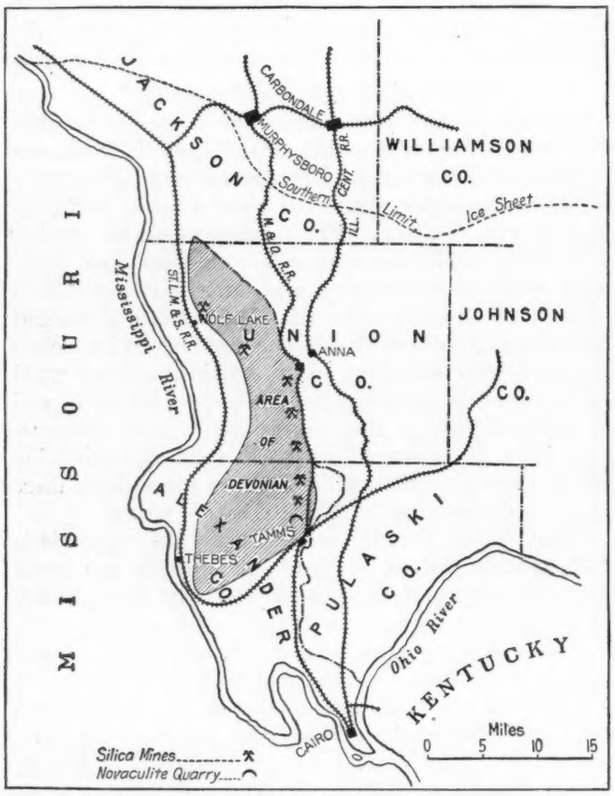


FIG. 1. SHOWING LOCATION OF AMORPHOUS SILICA DEPOSITS OF SOUTHERN ILLINOIS

counties and roughly paralleled by the Mobile & Ohio R.R. is an outcrop of Devonian strata, comprising several hundred feet of interbedded limestone, cherts and variously colored shales or slates, mostly green or brown. In the chert division, known geologically as the Clear Creek (Upper Oriskany) cherts, and of any thickness up to 250 ft., are found the deposits of amorphous silica. From these same strata is quarried the famous road-making material, novaculite gravel. Fig. 1 shows the situation of several of the more important silica mines and also of the novaculite gravel pits. Some of the more important silica-producing companies are: The Tamms Silica Co., Tamms, Ill.; R. A. Bautz & Co., Wolf Lake, Ill.; Frost Silica Co., Jonesboro, Ill.; and the Star Silica Co., Tamms, Ill.

From a commercial point of view the hard-chert, or novaculite, section of the Clear Creek chert should be differentiated from the bands that contain the soft silica. The former comprises the great mass of the strata and can be quarried by open-pit methods; the latter occurs in thin bands and is mined by underground methods, then ground to an impalpable powder for uses in the arts and industries.

The illustrations, Figs. 2 and 3, give an idea of the occurrence and thickness of the novaculite section of the Clear Creek cherts and were taken at the quarry or gravel pit of the Illinois Novaculite Paving Co., one mile north of Tamms, Alexander County. At this point the exposure is about 150 ft. in height, and from a distance looks like a marble mountain. The beds evidently have undergone long-continued surface alteration and disintegration enough to make feasible open-quarry operations on a great scale and with the use of a minimum amount of powder. The strata here are composed of layers of soft white or reddish chert interbedded with layers of very hard white chert several inches thick, which resemble the novaculite of Arkansas. These very hard layers are, however, somewhat shattered by vertical cleavage and offer no particular resistance when the whole height of the quarry is undermined by gopher holing, broken down by large blasts and then loaded into railroad cars by steam shovels.

If required, a screening plant at the quarry allows several sizes of the material to be made, or "pit run" may be shipped. A modern gravel washer and rock-crushing plant permit the preparation of special sizes. Much of the product, frequently amounting to 30 cars per day, is shipped to Mississippi and other Southern States, where it is used for making the famous hard white roads found there. The peculiar alternation of hard and soft layers in the cherts offers a particular advantage for road making, the softer layers acting as a binding material, while the hard fragments of novaculite take the wear under the traffic, besides furnishing a dust that is said to re-cement.

Of greater interest from the mining and milling point of view are those layers of the Clear Creek cherts which are composed of soft pure white amorphous silica and which contain the mines noted in Fig. 1. One of these beds is illustrated in Fig. 4, which also shows a typical entrance to one of the silica mines. The entire strata, above, below and in the bed being mined, seem greatly altered and decomposed, but the original bedding planes are preserved to a remarkable degree. The beds are generally horizontal, 5° being the greatest dip noted. Fig. 3 reveals pure white beds up to 6 ft. in thickness, interbedded with darker beds of about the same material, usually red in color and which in themselves are valueless, as the product milled and sold must be pure white

*Assistant professor of mining engineering, University of Illinois, Urbana, Ill.

in color. In underground mining operation these red layers delimit the mineable height and frequently serve as roof or floor to the workable deposit. Occasionally in mining operations the red streaks appear unexpectedly interbedded with the white and stop mining operations at that place. This is called "running bad," and the occurrence is said to be a "blossom" or a "scab" deposit. At some places the layers, which are red near the outcrop, are of a gray or bluish color underground probably from the fact that the contained iron has not oxidized. In view of the seeming disintegrated nature of the whole silica deposit, this is a rather remarkable feature.

A measured section in one of the mines showed, under a red roof: 7 to 8 ft. white silica but harder than that lower down; 18 to 24 in. red or bluish gray silica; 7 ft. silica, which was mined; 4 ft. hard rock silica.

What is the origin of these beds of amorphous silica? In Bulletin 4 of the Illinois State Geological Survey, page 185, a statement is made that "the origin and extent of the deposits is very imperfectly known and demands a thorough investigation." From a number of samples the following partial analyses are given:

No.	$\%SiO_2$	$\%Fe_2O_3$—Al_2O_3
205	95.14	2.38
207	95.18	1.04
210	97.20	1.28
211	95.78	1.80

The contained moisture in the freshly mined samples is not given, but is high and may reach 25%. The soft amorphous substance has a cold, clammy feel, but is not distinctly wet. Bulletin 18, Illinois State Geological Survey, page 37, mentions that the finely divided silica from southern Illinois is in reality a finely divided quartz, with the bulk of the material composed of particles less than 0.01 mm., or 0.0004 in., in diameter. The only other deposits of possible similar character known by the writer to have been described, are the so-called tripoli deposits near Seneca, Mo. (Bulletin 340, U. S. Geological Survey, p. 429-37).

While the SiO_2 analysis of these deposits resembles the Illinois deposits, it would appear that the nature of the materials is different. The methods of mining, preparation and many of the uses are essentially different. The tripoli is described as being massive with scarcely a trace of stratification, but divided into irregular blocks by variously inclined and curved seams or joints, and capable of being sawed into blocks 2 x 2 x 5 ft. These characteristics are in contrast to those noted for the Illinois deposits. Samples of the tripoli seem coarser-grained, more regular and less velvety to the feel than the Illinois silica. It is possible that the Illinois deposits are residual, representing the insoluble portions of a greater thickness of impure limestone. The even bedding and unoxidized blue-flint zones found underground would render doubtful this theory.

Deposition of the silica from thermal waters circulating along favorable channels parallel to the bedding planes at a time when erosion had not exposed the deposit offers a second possible means of origin which does not seem strengthened by examination.

A more probable origin is that involving solution of the amorphous silica during weathering of the superimposed strata and its subsequent redeposition and replacement of an original impure calcareous band. If so, the redeposition has been complete, as most analyses show above 95%, and it is said to have analyzed as high as 99.3 SiO_2.

All the mine openings are on the steep sides of hills that rise about 300 ft. above the valleys. From the outcrops the underground workings may penetrate several hundred feet into the hills. The method of mining is unique and may best be described as a checkerboard or square-work system. Passing underground, usually by a single entrance, the mine opens out into a series of parallel rooms driven about 10 ft. wide, 7 ft. high, and with about 20 ft. of pillar between. Every 20 ft. along the rooms breakthroughs of the same dimensions as the rooms are made in the pillars, thus giving the worked-out area the appearance of a checkerboard, with pillars 20 ft. square and at regular intervals supporting the roof. Occasionally irregular vertical seams filled with several inches of soft white gouge interfere with the regularity of the pillars, and to support the roof properly, it is necessary to keep these seams in the pillars. Every precaution is taken to carefully arch the roof of the rooms and thus avoid the necessity of using timber.

Fig. 2 Fig. 3
VIEWS OF QUARRY OF ILLINOIS NOVACULITE PAVING CO., TAMMS, ALEXANDER COUNTY, ILL.

For a mine, the underground scene is one of unusual beauty. The main roads in the mine are lighted with coal-oil wall lamps hanging from spikes that have been driven into the soft walls and reflecting the light on the walls, pillars, roof and floor, all of alabastine whiteness. Of added interest is the presence of mules and wagons underground, for the rooms are of sufficient size to allow the teams to go underground, drive directly to the face and load with about two and a half to three tons of mined silica. This is hauled to the grinding mills, often several miles distant.

The drilling and blasting methods underground are simple. The workable deposit is composed of alternate harder and softer streaks each up to six or eight inches wide. Selecting a soft streak (called a "lead") near the center of the face, the miner bores, with a hand auger, a 1½-in. horizontal hole to the depth of 2½ ft. at an angle of 60° to the face of the deposit. This is loaded with ¾ stick of 60% dynamite, and the center wedge is shot out; six other similar holes are put in the same streak and shot, in this way blowing down the center for the full width of the face. Finally, three holes drilled in a lead near the top and three near the bottom of the face are shot, which completes a round.

It should be remembered that in spite of being nearly pure silica, the rock is not sand or sandstone, and the soft walls, which look and feel not unlike layers of hardened flour, offer little resistance to boring with an auger. Occasionally hard lumps are encountered in drilling, in which case the miner has handy a short churn drill with which to break through the lump in the hole. If on the upper holes, he uses the churn drill over his shoulder after the manner of casting a spear.

The mineral silica, as shot down, varies in size from 12-in. lumps to the fineness of flour and contains considerable mechanically held and absorbed moisture, although it is only slightly moist to the touch. The first step in preparation is to screen through an inclined gravel screen having a 1½-in. mesh wire screen and set up underground near the face. Many chunks not passing the screen at first are broken with the flat of a pick and rescreened. Finally, about two-thirds of the material, containing about 25% of moisture, has passed the screen and is ready to be loaded. The oversize, which contains 15 to 20% moisture, at the present time is not treated, and is either left in the mines or dumped just outside. The reason for this is that the high percentage of moisture causes it to clog the rock breakers which have been installed in the grinding mills. In the near future this difficulty will be overcome, as there is no other reason why the coarse rock should not be milled.

The cost of mining and loading, with labor at $2.50 per shift, is probably from $1 to $1.50 per ton. Haulage to the mills costs about 12c. per ton-mile. Often the mined silica is sold to the mills on a royalty basis. In other cases small individual mine owners sell the material outright to the grinding companies.

Grinding or Milling for the Market

Very fine grinding is essential in preparing the silica for the market. This may be done by either a dry or a wet method. The dry-grinding tube mills have the disadvantage of producing dust, and the product may be uneven in size or grade. The product from the wet-grinding mills is "floated off" or classified in water, thus securing an even grade of product and the carrying on of operations without the production of dust. Two kinds of grinding mills are in use in the different wet-grinding plants, the "chaser" mill and the common horizontal cylindrical tube or pebble mill. The chaser mill consists of a single vertical cylindrical stone or edge runner about four feet in diameter, revolving about a central vertical shaft by means of a horizontal connection after the manner of an ordinary chilean mill. The grinding is done under water between the revolving wheel and the bottom of the pan, and when the silica is fine enough floats away in the overflow water.

In using tube mills, the 1⅛-in. mesh undersize hauled from the mines is fed with a minimum of water directly into the mills which have silex lining and use Newfoundland pebbles. The discharge from a tube mill flows in succession through a series of four shallow boxes, each about five feet square and two feet deep. In these boxes

FIG. 4. ENTRANCE TO WOLF LAKE SILICA MINE, UNION COUNTY, ILL.

all the silica that has not been ground fine enough to float or stay suspended in the slowly moving current of water settles out. The settled material from the first three boxes is shoveled out and returned to the tube mill for further grinding. The silica settling in the fourth box, although under 200-mesh in size, is still considered coarse, but is dried and marketed as "Settler" product, the coarsest and cheapest grade.

The milk-colored overflow from this fourth box is lifted by a steam jet into one end of the final settling pan, which is of concrete and 15 ft. wide, 2 ft. deep and 50 ft. long. The inside of the bottom is lined with steam pipes. The pan, starting empty, takes about 12 hours to fill with the settler overflow. After filling, the pan contents are allowed to settle undisturbed for five hours; the silica in suspension is so fine that it settles slowly, even in this still water; the clearest water is siphoned from the pan and reused in the tube mill; then live steam is turned into the pipes in the bottom of the pan and the water evaporated; after 48 hours only a crust 4 or 5 in. deep of dry silica remains in the pan; this is divided into three grades according to fineness. Of course, the coarsest slimes settle at the head end of the pan, and grades to the finest at the extreme lower end. The material at the head end is called "Velvetine," that at the center "Silver Bond" and the finest at the lower end is "Gold Bond." Any of the pan products are so fine that screening or touch tests are useless to determine fineness, although an

expert can readily determine comparative fineness by tasting. When touched to the tongue, the silica feels not unlike velvet, and this test is one that is not uncommonly used.

Each grade is shoveled out of the tank separately. On account of having been dried, they are somewhat caked, and are put through a Nordyke & Marmon buhr mill to take out all lumps. Here a Raymond dust collector system obviates dangers from breathing the dry powdered silica. Coming from the buhr mill, the material is run into sacks holding 200 lb. and is ready for shipment to the customer.

Owing to the power required for the tube mills and to the large amount of live steam used in the drying, the grinding mills are situated near the railroad tracks that coal may be available. The tube mills are 5 x 22 ft. and grind eight tons of crude rock per 12 hours, although on account of the contained moisture, this makes but six tons of product. Each tube mill takes 12 bags of pebbles per week.

The ground silica is used as wood filler, as a reinforcer in lead and zinc paints and as an inert material in mixed paints and varnishes where it replaces whiting and barytes. It is also used largely in scouring soaps, in the manufacture of high-grade metal polishes, both liquid and paste, and in many cases it takes the place of pumice stone and rottenstone in the metal and wood-finishing trades for rubbing and polishing purposes. The best billiard-cue chalks are made from the ground-silica products. This is not usually recognized, since chalk is popularly considered the best.

It is said that an addition of 25% of the finest grades of ground silica to zinc or lead paints causes them to wear longer and to withstand exposure to the weather without cracking or peeling. At the present time there is a considerable foreign demand for the pan-run grades for uses of this kind.

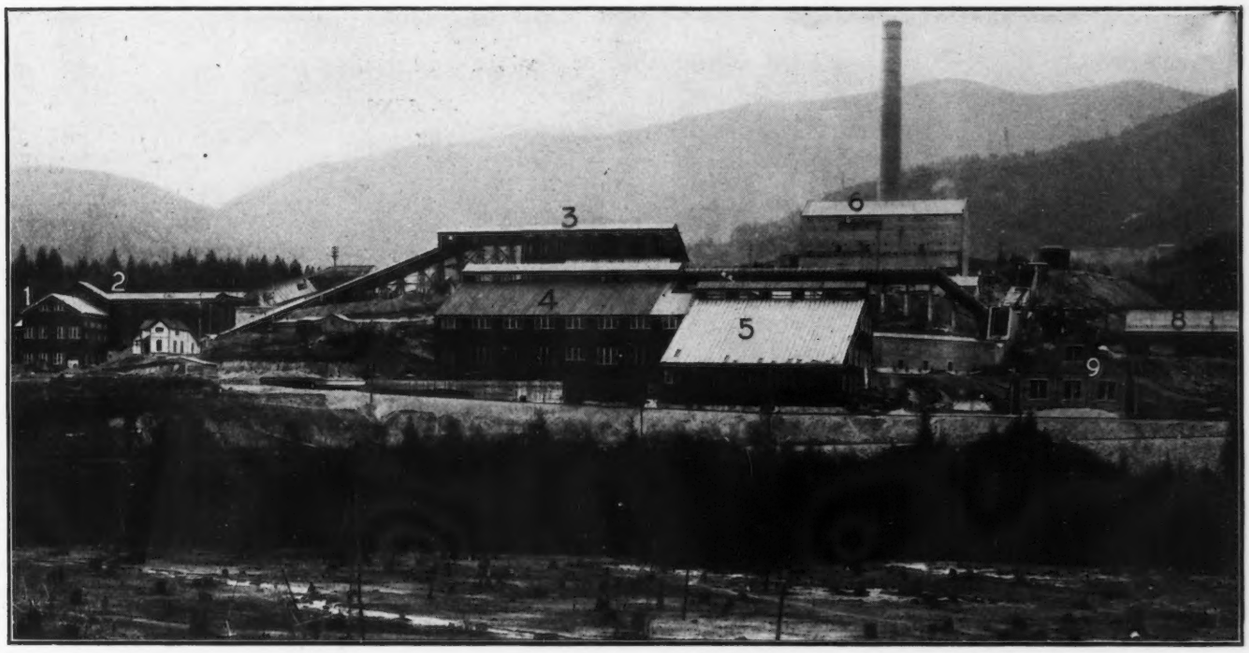
Bunker Hill Lead Works Ready

SPECIAL CORRESPONDENCE

The Bunker Hill & Sullivan works at Bradley, just below Kellogg, Idaho, is rapidly being completed, the expectation being that it will blow in about June 26, although in order to do this quick work will be necessary to complete the construction. The bins are now practically ready to receive ore. The receiving-bin gates discharge upon a conveyor belt in the sampling mill leading to the crushing rolls, samplers, etc.; reject is returned to any one of a number of storage bins in the same group as the receiving bins.

Crushed ore or concentrates in the storage bins can be delivered by the sampling-mill conveyor belt to the roasting department, where there are now one Wedge lead-ore roasting furnace and three Dwight-Lloyd sinterers. It is understood that two more sinterers are to be added and a second Wedge roaster for zinc. The Dwight-Lloyds will discharge sinter into cars on the track that runs over the receiving bins previously mentioned, and the sinter will be delivered to a group of furnace-charge bins where coke flux, sinter, ore, etc., will be stored.

There are three water-jacketed blast furnaces, each 48 x 180 in. at the tuyeres. The flue connection of the blast furnaces is below the feed floor, and a single charge-car track runs over the long horizontal axis of each furnace. There will be two settlers to each furnace. Matte will be tapped into a casting machine, while the lead will be tapped into ladles and carried by crane to the end of the building and dumped into the softening furnaces. These ladles are like those used for carrying matte in modern copper smelteries, although smaller. Steel hoods will be placed over settlers and at other points where fumes will be given off. Plans are being made in Wallace and Kellogg for an appropriate celebration of the blowing in of the furnaces.



BUNKER HILL & SULLIVAN LEAD WORKS NEARING COMPLETION AT KELLOGG, IDAHO

This photograph was taken early in June. The different structures are as follows: (1) Sampling mill, (2) storage bins, (3) roaster building, (4) blast-furnace building, (5) lead-refining department, (6) baghouse and Cottrell precipitation plant in rear, (7) main flue, (8) furnace-charge bins, (9) silver refinery

Phosphoric Acid Determination in Phosphate Rock

By C. Carleton Semple*

SYNOPSIS—Difficulty in obtaining molybdic acid or ammonium molybdate led to the substitution of the citrate method described, which proved equally reliable for the estimation of phosphoric acid in the material being handled. Details of application are given, together with suggestions for the use of fused quartz and alundum crucibles in place of platinum ware.

This method for the determination of phosphoric acid in phosphate rock is based upon the fact that if to a solution of the material in hydrochloric acid an excess of ammonia be added and then a sufficient quantity of citric acid, the phosphates of calcium, iron and aluminum thrown down by the ammonia are redissolved by the citric acid and an ammoniacal solution is obtained from which the phosphoric acid may be precipitated by the addition of magnesia mixture as pure magnesium-ammonium phosphate. The procedure is as follows: Weigh out 0.5 gram of the material if the rock contains 20% phosphoric acid or more, or a proportionately larger amount if the material contain less, and place in a porcelain casserole of 75 c.c. capacity. Cover with 10 c.c. of concentrated nitric acid and stir until all the material is moistened and effervescence ceases, then add 20 c.c. of concentrated hydrochloric acid, stir, cover and place on the hot plate to boil gently. If the material contains soluble silicates, the boiling must be continued to dryness and the residue baked to dehydrate the silica; then 10 c.c. of concentrated hydrochloric acid should be added and the boiling again continued to dryness and the baking repeated. Finally take up with 10 c.c. of concentrated hydrochloric acid and boil for a few minutes to dissolve all soluble salts. In the presence of soluble silicates this treatment is essential to prevent silica from contaminating the magnesium-ammonium phosphate precipitate. Ordinarily, soluble silicates are not present in phosphate rock and the boiling of the nitric-hydrochloric acids need be continued only until the volume has been reduced to 10 c.c. to effect complete solution of the phosphates.

Manipulation of Hot Acid

Upon removing the casserole from the hot plate, turn it about so as to cause the hot acid to run over the entire inner surface and dissolve any dried crusts, then immediately add boiling water until the casserole is nearly full, allow to stand a few moments until the residue subsides, then decant the bulk of the solution upon a filter paper, receiving the filtrate in a 300-c.c. beaker. Add 2 or 3 c.c. of concentrated hydrochloric acid to the insoluble matter in the casserole, again fill with boiling-hot water, and pour upon the filter, washing all the residue out of the casserole with a jet of hot water. Wash the insoluble matter on the filter with boiling water until the total bulk of the filtrate is from 175 to 200 c.c. To the filtrate add ammonia a little at a time with constant stirring until the gelatinous precipitate of lime, iron and alumina phosphates begins to form; then add 30 c.c. of 0.90-sp.gr. ammonia and stir well.

Now add 10 c.c. of saturated solution of citric acid and stir for two minutes. If all the precipitated phosphates are not redissolved, add a little more citric acid, drop by drop and with constant stirring, until the solution is perfectly clear. Add 30 c.c. of magnesia mixture, stirring until a precipitate begins to form. Under the conditions herein outlined I have found that the precipitate invariably begins to form in two minutes even in warm solutions and is often complete in 1½ hours, but it is advisable to let it stand at least three hours, and even then it is well to keep the filtrate for 24 hours to make sure that the precipitation has been complete.

Handling After Precipitation

After standing until precipitation is complete, the supernatant solution is decanted from the precipitate that has settled to the bottom of the beaker through a filter paper, as much as possible of the precipitate being retained in the beaker. When all but 15 or 20 c.c. has been decanted off, add 30 c.c. of washing solution, made up of one part of strong ammonia to two parts of water and containing 25 grams of ammonium nitrate per liter, to the precipitate. Agitate, allow to settle, and decant off the clear solution. Now wash the filter well with washing mixture and then wash all the precipitate from the beaker into the filter and wash twice with washing solution. Some precipitate will adhere to the sides of the beaker and must be removed by a rubber. I use a stirring rod made of ⅛-in. glass tubing sealed at each end and over which a piece of tightly fitting rubber tubing is drawn for its full length. This "rubber" is preferable to the usual "policeman" with a bit of tubing on only one end of the rod. Having washed all the precipitate into the filter, remove it from the funnel, place in a crucible, dry, ignite and weigh as $Mg_2P_2O_7$. The result, multiplied by 0.6376 gives the weight of P_2O_5.

The magnesia mixture is made as follows: Dissolve 110 grams of crystallized magnesium chloride in water and filter. Dissolve 280 grams of ammonium chloride in water, add a little bromine water, a slight excess of ammonia, and filter. Add this solution to the solution of magnesium chloride and add 30 to 40 c.c. of strong ammonia water, enough to impart a decided odor, then dilute to 2 liters.

It is customary in the phosphate-mining regions of the Southern States to weigh out a much larger quantity of material than I have mentioned, even as much as 5 or 10 grams, which is treated with acids and filtered, the filtrate being received in a 250-c.c. standard flask. After diluting to the mark and mixing thoroughly, an aliquot part is drawn out with a pipette and the determination made with this fraction. I have found no advantage in this procedure.

The method herein described checks with the customary molybdate method, as shown in the accompanying table, in which the determinations by the molybdate

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method were made by a chemist with long practice in the analysis of phosphate rock for export. The advantage of the citrate over the molybdate method is that there are fewer filtrations, and the two that are necessary are quick-running and the residues easily washed. I usually run ten samples in a group, and the time required from starting to weigh out until ready for the addition of magnesia mixture is one hour and a half. Four samples may be run together in one hour. A further advantage is that approximate results may be obtained at the time of adding the citric acid, as the amount of citric acid required is proportional to the amount of phosphoric acid present. Instead of using a saturated solution of citric acid, a solution of half this strength is made up and is standardized against a sample, the phosphoric-acid content of which is known. After adding the ammonia, the citric acid is run in slowly from a burette, finally drop by drop as the solution clears until the last drop leaves the solution perfectly clear. The solution must be stirred vigorously and toward the end the stirring should be continued for a minute between each addition. The end-point is the perfect clearing of the solution as the last of the precipitate is redissolved. The analysis should be continued thereon by precipitation with magnesia mixture, because the results obtained from measuring the amount of citric acid required are not close. The end-point is obscure, and diluted solutions of citric acid do not keep their strength. Results at this stage will, however, check within ½ to 1% of those obtained later. In running mine samples it is often preferable to get an approximate result quickly rather than to wait for accurate figures.

COMPARISON OF RESULTS BY MOLYBDATE AND CITRATE METHODS

% P_2O_5 by Molybdate Method	% P_2O_5 by Citrate Method
26.01	25.96
26.26	26.24
24.03	24.08
25.11	25.12
23.40	23.31
24.60	24.51
24.86	25.00

I developed this citrate method because for a long time it was impossible to obtain either molybdic acid or ammonium molybdate. At first I used the method for the determination of phosphoric acid in limestone as given in Low's "Technical Methods of Ore Analysis," where the phosphoric acid is precipitated from the hydrochloric-acid solution, to which ferric chloride has been added to supply enough iron to combine with all the phosphoric acid present, by the addition of ammonia which throws down a precipitate of ferric phosphate and the excess of iron as hydroxide. Acetic acid is then added in quantity sufficient to give a decided acid reaction and the solution boiled to redissolve the hydroxide. The ferric phosphate is not redissolved, but is filtered out, redissolved in a little hydrochloric acid, and the phosphate again precipitated in the same manner. The second precipitate is filtered out, dissolved in a little hydrochloric acid, citric acid is then added to prevent the precipitation of the iron, and then the solution is made strongly ammoniacal and magnesia mixture added to precipitate the phosphoric acid as magnesium-ammonium phosphate. The precipitate of ferric phosphate is bulky, filters very slowly and is difficult to wash, making the method tedious and requiring much time. At first I regarded the modification I made of Low's method as a slop method suitable for mine samples only, on which very accurate results were not so much desired as quickness in getting them. Later, as opportunity arose to run samples by Low's, the citrate, and the molybdate method in comparison, it developed that the three methods checked so closely on the material I was analyzing that for a long time since I have used only the citrate method, and my results have always checked with those obtained by umpire analyses.

I have been using substitutes for platinum crucibles for phosphate work and find that both vitreosil (fused quartz) and alundum crucibles are quite satisfactory. Phosphate work and gasoline blast-lamps are particularly hard on platinum. It takes more time to burn off the filter papers when using these crucibles over blast lamps than platinum, but in case the laboratory is equipped with a muffle furnace the difference in time is not of consequence; and at present prices for platinum one may install a gasoline-fired muffle furnace and burn a dozen or more filters at a time for the price of two platinum crucibles. One disadvantage of the quartz or alundum crucibles compared with platinum is that they are not so convenient for weighing the precipitate in the crucible, and taring the crucible.

In making a complete analysis of phosphate rock special methods are required for the determination of total lime. The method I use is as follows: 0.5 gram of material is treated in a casserole with nitric and hydrochloric acids as given for the solution of the material for the determination of phosphoric acid. The acid is entirely boiled off and the residue dehydrated. Hydrochloric acid is then added and the casserole again heated until the contents are dry. Finally add 15 c.c. of concentrated hydrochloric acid, boil, add 50 c.c. boiling water, filter, and wash. Iron cannot be separated from the filtrate by the addition of ammonia, as calcium phosphate will be thrown down. Therefore add ammonia until a precipitate begins to appear, then add hydrochloric acid drop by drop until the filtrate is clear again. Add 2 c.c. hydrochloric acid in excess, heat to boiling and add 5 grams of oxalic acid in crystals and, when dissolved, 40 c.c. of boiling saturated solution of ammonium oxalate. Boil 30 minutes, filter, wash with boiling water until all oxalates are removed, then ignite and weigh as CaO or dissolve in sulphuric acid and titrate with standard permanganate. The free oxalic acid keeps the iron in solution. Low results would be obtained if one attempted to precipitate calcium oxalate in an ammoniacal solution.

Boring for Potash in Texas

Despite some delays in getting supplies, boring is progressing rapidly on the prospect well which is being put down by the United States Geological Survey at Cliffside, Texas, where geological conditions are favorable to the occurrence of potash. The drill now is past the 1300-ft. level and sinking is proceeding at the rate of 20 ft. daily. The great salt series has been encountered. The analytical work is considerably behind the drill. For this reason the content of the core has not been determined since the horizon in which potash may be present has been entered.

In addition to those from its own well, the Geological Survey is examining the cores coming from twelve other wells in the same vicinity. The Survey's chemist, who is stationed at the well, visits the other properties at regular intervals.

An Ore-Testing Laboratory

By Carl J. Trauerman*

SYNOPSIS—A testing laboratory was designed, built and equipped, care being given to a study of the best methods for facilitating work. Apparatus was planned to provide means for solving all the problems of ore treatment.

A number of years ago I was called upon to make some tests to determine a feasible milling process for the silver sulphide ores of Butte providing an economical recovery of gold and silver. Under the direction of John E. Rothwell and myself, a laboratory was equipped with small machines, as described here, and the equipment was so arranged that it is possible to test any ores requiring concentration and fine grinding cyanidation. After finishing a number of tests on the Butte ores, this equipment was used in connection with a great many ores from all over the western part of the United States. In view of its elasticity and general adaptability a description of the apparatus may be of interest to those who contemplate preliminary testing on a small scale.

A flow sheet is given in Fig. 1, showing the arrangement used to test the silver sulphide ores from the Ophir mine of the Butte Central Copper Co., now the Butte & Detroit Copper Co. In this case the ore was first crushed on a large steel plate to about ½ in. cubes. About 100 lb. of the ore was taken to be tested.

Laboratory Equipment

The small coffee-mill was used to crush the ore for coarse concentration in a gold pan, by which good results were obtained. The pulp was then dewatered by decantation and the coarse pan tailings loaded to the ore bin whence, by a trip feeder worked from the periphery of the conical mill, it was fed through a small chute to the latter. A small amount of water was added at the feed to facilitate grinding. The feed and discharge necks of the tube mill were placed in sliding wooden bearings so that the mill could be sloped to discharge any fineness of pulp from 100- to 200-mesh. This discharge was fed to the stationary canvas table where dressing water was added. The table was set on a sliding frame so it could be sloped to any pitch desired. The tailings from the table entered the filter tub where they were allowed to settle, the supernatant liquid then being decanted until the pulp was at the desired consistence. The filter leaf was then immersed and the pump started. About 15 in. of vacuum was indicated on the gage, and by this arrangement any time-cycle of filtration could be adopted. The pulp was usually drawn down to 18% moisture, which was either considered when charging the cyanide tanks or replaced by cyanide solution.

The pulp was then charged into one of the agitators, lime and cyanide solution added, and the mass set in agitation. Afterward the pulp was put into a filter tub, thickened and then filtered, the decanted solution being added to the filtrate from the vacuum tank and the whole solution being precipitated by the jar shown in Fig. 1.

From the foregoing outline it will be seen that this flow sheet was very elastic and could be arranged to suit the will of the operator as to time, arrangement, intensity, etc.

The coffee-mill crusher used is a stock machine manufactured by the Colorado Iron Works company and driven by an individual motor. It has a double discharge which saves one step in the quartering of the ore. Ore can be fed into this machine at ½-mesh and crushed to any mesh up to 80.

The gold-pan used was a simple miner's pan. It was our object to obtain very clean concentrates, and to remove sulphides detrimental to subsequent cyanidation. About five pounds of ore could be handled at one panning, and from the tests made a good idea could be obtained as to what could be accomplished on sand tables in the mill, excepting, of course, the matter of slope of table, feed, and dressing waters, etc. To determine these points it

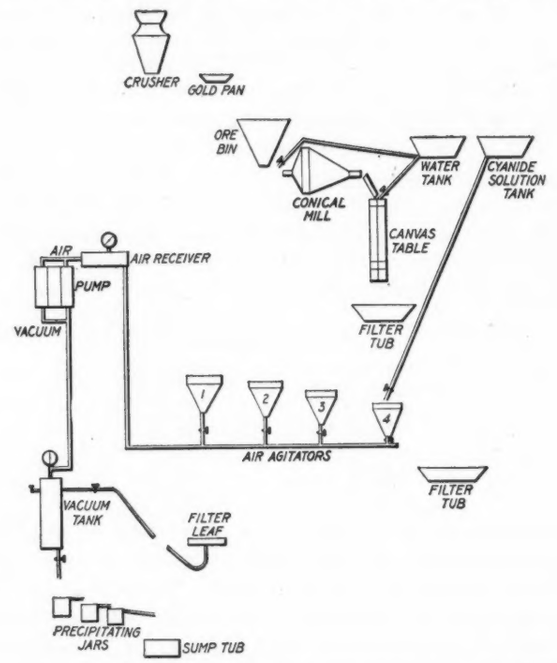

FIG. 1. FLOW SHEET OF ORE-TESTING LABORATORY

would be necessary to have a laboratory table fashioned after the type of the larger mill unit and working under a continuous feed.

The ore bin was constructed of 1-in. boards and was made fairly water-tight. The feeder was a kind of launder under the mouth of the ore bin. At one end of this launder was a pusher operated through a lever and a trip on the periphery of the conical mill. This feed could be regulated by shortening or lengthening the levers to arrange the desired amount of feed. At the other end of the feed launder was a pipe screwed into a disk. This disk was stationary and was planed so as to fit snugly over the revolving end of the conical mill. The latter arrangement furnished a satisfactory method of feeding.

The conical mill used is shown in Fig. 2. It was constructed of No. 16 iron, with cast-iron liners $\frac{1}{16}$ in. thick. Where the two cones of the mill meet, the iron is flanged and the flanges coupled with bolts. A rubber gas-

*Mining engineer, Butte, Mont.

ket made this joint water-tight. The liners were riveted to the shell, lampwicking being put around the rivet heads on the inside of the mill. A wooden casing was put in the space to the left of the flange. This was 2 in. thick and rounded and was bolted to the flange and used as the driven pulley when operating. This pulley was 2 in. wide and was driven by a lineshaft which was in turn driven by a ½-hp. motor. The mill was charged with either flint pebbles or steel balls. We found the most efficient crushing steel to be a short cylinder with tapered ends. This shape gave a great grinding surface and did not tumble in the mill, but kept a horizontal axis. We never investigated this phenomenon to any great extent, but it might offer a field for research. We found that these cylinders wore to a taper similar to the shape of the mill. At this stage they did their most efficient grinding, the wear being uniform on the tip and sides of the cone. Such a phenomenon may occur only in a conical mill. We have never had occasion to try it in the cylindrical ball mill, but as I have said, it might well be worthy of investigation.

The stationary canvas two-compartment table is shown in Fig. 3. This was made entirely of wood, the compartments being separated by a 2-in. strip. Coarse-meshed canvas was tacked in the 8-in. spaces. By placing this table on an adjustable stand, any desired slope could be obtained. The ore was fed into the compartments *A* (Fig. 3) and dressing water was added from the low-pressure water tank (see Fig. 1). A good slime concentration could be effected on this table on material running as fine as 200-mesh. After the ore was passed over the table, a small hose was used to wash off the tailings into a tub placed at the discharge. At *B* (Fig. 3) are shown the slots over which the canvas was lapped, which could be removed so as to wash the concentrates from the canvas by means of a strong stream of water, and a bucket was placed under the openings at *B*, to catch these concentrates.

The filter leaf was constructed of a piece of 2-in. plank and was sawed 1 ft. square. A piece of coarse-mesh iron screen was nailed on top of this board, then a piece of burlap, and on top of this a piece of fine-mesh canvas. Wooden strips were then nailed around the edges of the boards to keep the cloths tight. The filter was bored in the center so as to admit a ½-in. pipe nipple. This nipple was attached to a hose which led to a connection with the vacuum tank.

The vacuum tank was a piece of 5-in. pipe capped at both ends, the top cap being bored to admit the pipe from the suction pump, and the bottom cap was bored to make an outlet for the solution or water. The connection between the filter and the air-release pipes was screwed directly into holes bored into the upper part of the pipe. We did not use vacuum and air pressure at the same time. The suction was obtained through the valves of this vacuum tank when using the pump as an air compressor.

The pump was a small home-made affair containing two cylinders. We obtained as much as 10 lb. pressure from it, and it gave all the air needed for laboratory work. It was driven from the conical-mill lineshaft. The air receiver was a common water boiler, as used in kitchens.

The agitator is shown in Fig. 4. This tank was developed to use the counter-current agitation system described by John E. Rothwell in the July and September, 1911, issues of *Metallurgical and Chemical Engineering*, under the headings of "Continuous Cyanide Treatment of Gold and Silver Ores" and "Counter-Current and Continuous Agitation" respectively. This agitation system consists merely in working the solution counter to the flow of the ore. In the prevailing continuous-agitation practice, as the ore becomes poorer the solution becomes richer and the ores passes from one agitator to the other without the addition of the fresh solution so necessary with certain classes of ore. Without dilution, the solution passing to the filters will be rich in dissolved metals. By means of the Rothwell system the ore as it gets poorer is constantly meeting freshened solutions which are low in dissolved metals. When the pulp reaches the last agitator, most of the dissolvable metals are extracted. The counter-current feed, consisting of barren solution,

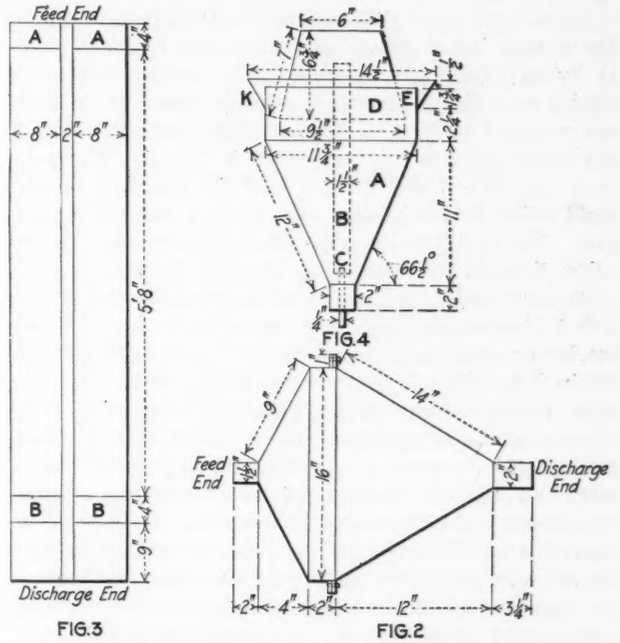

FIG. 2. THE CONICAL MILL. FIG. 3. THE CANVAS TABLE

starts at the last tank, hence the feed filter is ideal so far as dissolved metal in the solution is concerned, and the mechanical dissolved metal loss in filtering is at a minimum.

In order to carry on this counter-current replacing system, it is necessary to obtain a clear solution in the agitator. In Fig. 4 the pulp is agitated through the central tube *B* and discharged at the top. This central tube can be made any desired length. The discharged pulp from *B* is splashed in the space *D*, protected by the sheet-iron truncated cone shown in the sketch. The pulp then travels down the space *A* and is again led into the central tube *B* and lifted by the air current supplied at *C*. During this operation the space *E* contains a clear solution, which overflows into the launder *K* and is ready for return to the preceding tank. The depth of the clear solution at *E* can be regulated by raising or lowering the truncated cone.

The central tube *B* may be held in place either by connecting it by means of a piece of flat steel to the side of the tank or by fastening the supporting flat steel to a plank running beside the agitator. In either case the flat steel supporting band should be constructed so that

it is possible to slide the central tube up or down. The tank may be fastened to the wall by brackets. The truncated cone can be hung by a string to a strip of wood above the tank so that this cone may be raised or lowered. If it is desired to test by the simple charge system of agitation, this truncated cone may be removed entirely and the overflow launder may be filled with some kind of removable filler.

In Fig. 1, showing the laboratory arrangement for using the counter-current method, the truncated cone has been omitted for the sake of clearness. It will be noted that each tank is placed on a lower level than the one preceding it. A certain proportion of the pulp from No. 1 tank was cut by a vane over to No. 2 tank, and the same step took place from No. 2 to No. 3 and from No. 3 to No. 4. This pulp entered each tank in the space *D* (Fig. 4). The barren solution was fed into tank No. 4 (Fig. 1) in this same space. The overflow solution from the launder in tank No. 4 was lifted back to the space *D* (Fig. 4) by an air-lift arrangement. This arrangement was carried on until the overflow solution from No. 2 tank was returned to No. 1. The overflow from tank No. 1 was precipitated in the jars shown in Fig. 1. The pulp from tank No. 4 was filtered, and the resultant filtrate could either be precipitated or used as a counter-current feed. The agitators could be arranged for receiving air either through the bottom or through the top.

Besides the equipment described, 16-oz. copper flasks with flaring mouths were used to run bottle tests. There has been much discussion as to the practical knowledge obtained from bottle tests in cyanidation with reference to the practice of charging a bottle and using hand-shaking as a means of agitation. Some engineers claim that making such tests are a loss of time, while others claim that if economical extraction cannot be made in a bottle test commercial extraction is impossible. We believe in materially qualifying both these claims, especially in testing silver sulphide ores. On some ores the same extraction may be made in the bottles as in actual practice, with probably the same amount of consumed chemicals, while with other ores this is impossible, especially when air is not introduced and the solution becomes foul before possible extraction is completed. In the latter case, if air were introduced it might clean the solution of its foulness. However, it is not practicable to introduce air into these small tests, as there is a tendency to evaporate the solution. In both claims for the bottle tests the time factor cannot be accurately determined.

The bottle tests may be used for comparative work; that is, for judging the cyanide strengths, dilution, amounts of lime or other reagents that give the best results. It is a great deal easier to determine these factors in bottle tests on small quantities of ores than in larger quantities in regular agitation apparatus. In this way the bottle tests may be valuable as a time and material saver before resorting to larger tests.

Advantages of Bulk Cement*

Why not do away with the cement sack when possible? Cotton, paper and burlap are scarce and high-priced. Sacked cement is largely a habit. We stopped using barrels because sacks seemed more convenient. But hundreds of thousands of barrels of cement has been shipped in bulk and where handling in this form is practicable, it is more convenient and also cheaper. The cost of a sack of cement includes that of the sack. On large jobs money tied up in sacks represents money that might better be in working capital. Sacks can, however, be redeemed if taken care of. But efforts to do so go wrong at times because workmen misuse or appropriate sacks for their personal use.

Objections to the use of bulk cement fail before the testimony of those who have used it in large quantities. It is no longer an experiment. Where cement is used directly from the car at a rate of 50 bbl. a day or more, bulk cement permits a saving of from five to ten cents per barrel. Five cents a barrel means saving of $10 on the average carload. Emptying, shaking, counting, sorting, bundling and shipping sacks is done away with. This has often increased the efficiency of the construction gang about 10% in the amount of concrete mixed and placed.

Cement in bulk is not likely to suffer as much damage in transit as sacked cement. Even a leaky car injures the former less than the latter, when the sacks as well as the cement are damaged. Bulk cement does away with freight charges on returned sacks and the clerical work of keeping track of them until redeemed.

No special equipment is needed to handle bulk cement. The wheelbarrow that is good enough to measure aggregates can also be used to measure cement. Less dust comes from handling it because there are no sacks to be shaken.

On many jobs storage facilities for bulk cement are unnecessary. It is both practical and convenient to use it directly from the car as needed. If storage is required, tight water-proof bins, preferably of the overhead type, should be used. Bulk cement is particularly adapted to the requirements of concrete products plants.

*An abstract of a bulletin issued by the Portland Cement Association.

Carbon Monoxide Poisoning

The Bureau of Mines has issued a report on carbon monoxide poisoning in the steel industry. Attention is given primarily to the danger of chronic poisoning caused by daily exposure of employees to small quantities of this gas over an extended period of time, rather than to that of acute poisoning, or "gassing." The latter rarely occurs except where the atmosphere is suddenly and grossly polluted with gas because of a breakdown or faulty operation of machinery. The continued presence of a little of this gas, though insufficient to cause acute symptoms, will nevertheless finally bring about the total or partial incapacitation of the worker.

The rapid changes in the steel industry have caused an increasing manufacture of carbon monoxide either as a product or byproduct. Gas from blast furnaces that was formerly wasted is now collected and utilized to produce power. The gas engine has gradually supplanted the steam engine. The increasing use of gas in openhearth furnaces has led to its extensive manufacture in gas producers. New processes of manufacture offer other possibilities of carbon monoxide poisoning. The large demand for refractory materials for steel plants has brought about the preparation of dolomite. In all these the danger to the employee, though insidious, is real.

Platinum Deposits of the World*

Platinum is a necessary metal in many industries closely connected with war. The known supply of the metal is limited; possibly 5,000,000 oz. has been produced in the world to date. Estimates based on the official figures of production from Russia since 1843, which are taken as 25% low, and on the assumption that Russia has supplied 95% of the world's output, indicate that the total quantity of crude placer platinum produced in the world since 1843 has been less than 4,632,000 Troy oz., or about 109 short tons. Platinum is here taken to include not only the single metal, but all the metals of the platinum group—palladium, iridium, rhodium, ruthenium and osmium.

The United States alone apparently uses in the neighborhood of 65,000 oz. of fine platinum a year, of which approximately 50% is used in jewelry. In this connection it is interesting to note that in 1915 about 44,000 oz. of platinum was in use in the contact process for the manufacture of sulphuric acid in the United States, and it seems reasonable to assume that contact plants in the world have at least 500,000 oz. The quantity of platinum in chemical and physical equipment in the world can not be readily ascertained, but an estimate may be hazarded as 1,000,000 oz. Electrical devices may have used half that quantity, but it seems probable that platinum now in use in that industry is not so large, say 250,000 oz. The jewelry industry has probably consumed at least 1,000,000 oz. and the dental industry about 1,000,000 oz. Minor uses and hoarded platinum will account for the remainder of the probable supply derived from the known placer deposits.

Sources of Platinum

With the exception of a little platinum and allied metals obtained by refiners of copper and nickel mattes and gold bullion, the origin of which is not further discussed in this paper, all the platinum in the world has come from placer deposits. Attempts to trace platinum to its source have proved successful, particularly in Russia, Spain and Canada, but none of the deposits of platinum in the mother rocks has been found of commercial grade under normal conditions. It should be mentioned that a primary deposit in Russia is reported under development at the present time, owing to the remarkably high prices of platinum.

The mother rocks of platinum are basic igneous rocks, peridotite, pyroxenites and dunites. The peridotites and pyroxenites are dark gray to black, heavy rocks composed principally of black or dark green iron-magnesium silicates, pyroxene, augite and hornblende, and olivine, plagioclase feldspar, chromite, ilmenite and magnetite. Dunites are composed principally of olivine with some chromite. There is every gradation between these types of rocks and the less basic rocks. A characteristic of the basic rocks is their tendency to alter to serpentine, a soft greasy fibrous mineral of olive-green to black color that once seen is readily remembered.

The placer deposits containing platinum are all, so far as known, in the vicinity of areas of rocks of the type described, and it would seem that in any search for new deposits of platiniferous gravels the first step is the search for outcrops of peridotite, pyroxenite and dunite. When areas of these rocks have been found, the gravels of the streams rising in them should be washed to ascertain if platinum is present. The heavy concentrates found in gravels carrying platinum are usually rich in chromite and olivine. The character of the rock particles often gives a clue to the source from which the gravels were derived.

Platinum is not known in all countries in the world, but that all the deposits of this valuable metal are known is hardly possible. In fact, platiniferous deposits in southern Spain have been discovered recently by a geologist working on the assumption that the place to look for platinum was in areas of basic rocks similar to the typical Russian rocks. Systematic search, based on similar assumption, in all countries may lead to the discovery of new deposits of platiniferous gravels of economic importance, but a note of warning should be sounded. In Russia such systematic work has been in progress for a number of years, and while new deposits have been found, they are not so numerous nor so rich as the hope of the explorers anticipated.

Russian and Colombian Deposits

The Russian platiniferous gravels are situated along a belt of discontinuous elliptical outcrops of basic igneous rocks, which are exposed near the summit of the Urals, particularly on the west side of the mountains, that are larger and more continuous in the north and central Urals than farther south. The concentration of platinum in the gravels is the result of a very long period of weathering and erosion, and the richer gravels have probably been reconcentrated. That is, the originally deposited gravels have been worked over and over by streams and their platinum content concentrated in a small bulk of gravel. The deposits most extensively worked are in the South Verkhotursh, Perm, North Verkhotursh and Cherdinak districts, though several outlying deposits are known.

Colombia, South America, is the second largest producer of platinum in the world. The principal deposits are reconcentrated stream placers at the headwaters of the San Juan River, which enters the Pacific Ocean North of Buenaventura. Platinum is known to exist in the upper Atrato River, which flows north, entering the Caribbean Sea through the Gulf of Darien. Gold is associated with platinum in all the streams, but it is reported to be more abundant in the Atrato drainage than in the San Juan. Little is known concerning the geology of this part of the west slope of the Andes and Pacific coast region of Colombia, and scientifically conducted exploration in this region would appear to be well worth the careful consideration of capital. It is reported very recently that the Colombian government, recognizing the need of detailed work, has planned for a scientific study of the mineral resources of the country. An American-controlled company is operating one dredge on the Condoto River and will shortly install a second boat. Two other small dredges are reported to be in operation in the district, but there are large areas of practically virgin ground which appear to be worthy of careful prospecting.

In Minas Geraes, Brazil, platinum has been known for some time in the gold washings of the Rio de Velhas, but apparently the supply is not large. Platinum is also

*An article by James M. Hill, U. S. Geological Survey, published in "Commerce Reports," Washington, D. C., Apr. 23, 1917.

reported to be present in the veins at Gorgo Seco and also in some of the itabirite of Minas. A study of these occurrences might be profitable, though it is believed that the studies of these occurrences already made would have led to development if any considerable bodies of platiniferous material had been found, so that the lack of development indicates nothing favorable.

Platinum is known to exist in streams in southeast Borneo, which rise in the Bobaris Mountains, which are composed of schists and gneisses that have been intruded by basic igneous rocks. A litle scientific prospecting has been done in this region, but there appears to be a chance for more detailed work to be profitable.

Platinum has been recognized in several of the Australian provinces, notably New South Wales, Queensland and Tasmania. On the east-coast beaches, near the boundary between New South Wales and Queensland, platinum occurs with gold, tinstone and monazite, but in a very fine state of subdivision. The problem of saving the valuable materials is technologic and appears not to have been satisfactorily solved up to the present time on account of this and other difficulties.

In the Fifield and Platina districts in east-central New South Wales platinum has been won from a buried gravel channel, the richer parts of which, according to the reports of the government geologists, appear to be nearly worked out. Great difficulties were encountered in securing an adequate supply of water for washing, and the low-grade gravels have not been worked.

In northwestern Tasmania, 20 miles west of Waratah, platinum has been obtained from the gravels of Nineteen Mile Creek and other tributaries of Savage River, and it was reported that the source of the platinum has been located in serpentinized basic rocks.

Within the last year scientific geological exploration in the Sierra de Ronda Mountains in southern Spain resulted in the discovery of platiniferous gravel deposits, which may prove of economic importance. The results of this exploration show conclusively what can be done by a systematic geological search for this essential mineral.

Work of United States Geological Survey

In North America platinum is known to exist in the gravels of a number of streams in the western mountains, both in Canada and the United States. The known Canadian occurrences are principally in the Tulameen district, not far north of Oroville, Wash. In the United States the production of placer platinum has been limited to streams rising in the belt of serpentine rocks in central California and from the serpentine areas in Siskiyou and Trinity Counties, in the northwestern part of the state, which continues northeast into Curry, Josephine and Jackson Counties, in southwestern Oregon. Platinum has also been recognized in the gravels of streams rising in the Blue Mountains of eastern Oregon and at various places in the Cascade Mountains of central Washington. The United States Geological Survey has already made plans for an immediate survey of all possible areas in the Western States, with a view of developing both the well-known and new localities.

Quite recently platinum has been found in certain widely scattered stream placers in Alaska, and plans have been made for a study of the subject in that territory by geologists of the Survey. It is probable that the study will lead to important knowledge of the deposits.

Raw Materials for Sulphuric Acid

Washington Correspondence

Spanish pyrites formed 40% of the raw material used in sulphuric-acid making in the United States in 1916, when 1,100,000 long tons was used. With the decrease of ocean tonnage available for transporting this material, the acid manufacturers are facing the necessity of finding a substitute. This problem has also been taken up by the Bureau of Mines.

There are three ways in which the shortage of imported pyrites can be offset; namely, by using domestic sulphur, the increased production of sulphuric acid at smelteries, and the development of new deposits of pyrites or related sulphides such as marcasite and pyrrhotite.

To draw upon the sulphur deposits of Louisiana and Texas, the only large domestic sources, to an annual extent equal to the sulphur content of the pyrites imported from Spain last year, which was at least 500,000 long tons, would probably be a serious drain upon them.

Increase in acid production by smelteries could be accomplished only by improvements in methods or by increased equipment, except at such existing acid plants as might be producing less than full capacity. Changes of this sort would take time, nine months being the shortest period in which increased production could be so obtained.

New deposits of available iron sulphides could be made productive only after the delay of the development period. Further, a plant designed to roast pyrites might experience difficulties if pyrrhotite were substituted. This sulphide, which contains less sulphur than pyrites, is being experimented with.

Efforts are being made by the Government to encourage the production of domestic pyrites in the belief that the war will be of such duration that this supply will be needed even if it takes a year to make it available. It is hoped that the domestic ores may find a permanent market. Deposits developed at a distance from the seaboard it is believed, will be able to compete with the Spanish pyrites after the restoration of normal shipping conditions.

There is an increasing tendency to use the residue, after roasting, for iron ore. Roasting processes have been so perfected that practically all the sulphur can be removed. This leaves the residue suitable for iron ore. Formerly, it was unprofitable to handle the residue after its passage through the acid plant.

Attention is being paid to the sulphur-bearing coals. Mine operators are being requested to save the coal rejected because of its sulphur content. It is thought that here lies an opportunity to increase the sulphur supply materially. With all these endeavors to increase the domestic supply of pyrites, the need of keeping up imports is kept in mind. Pyrites is to be loaded on the return voyage whenever it is practicable.

Origin of Silver Ores of Cobalt, Ont., are described in "Economic Geology" for April-May, 1917, by Edson S. Baston, who states that chemical actions which are known to take place if acidic sulphate solutions carrying silver and iron are brought in contact with the minerals characteristic of the Cobalt ores, appear adequate to explain all the replacement phenomena of the ores excepting the replacement veinlets of native silver in the ferruginous calcite. Genesis of the ores of the district is ascribed to downward enrichment, chemical formulas and reactions being given to substantiate the statements made.

Equivalent Cost of Coal and Oil as Fuel*

By R. L. Wales†

SYNOPSIS—Besides showing a chart to assist in quickly determining the equivalent cost of coal and oil fuel, the author considers some of the advantages of oil.

In the present day of high prices of all grades of coal, the power-plant manager naturally turns to the possibilities offered by fuel oil in his efforts to keep down the cost of operation. The problem of substituting fuel oil for coal is no longer one of engineering difficulties, but rather one of relative expense, all phases of the power problem being considered. If it were true that equal costs per million B.t.u. from coal and from oil meant equal operating costs, the problem would indeed be simple. A brief calculation involving heating values and costs per pound would settle the whole question. The difficulty of the problem arises from the fact that, owing to incidental economies peculiar to the use of oil fuel, a million B.t.u. from the latter is equivalent to considerably more than a million B.t.u. from coal in the matter of power generation. In other words, it will usually be true that a considerably higher price may be paid per million B.t.u. for heat from oil than from coal, still keeping the total cost of power production the same.

Some of the specific offsets to higher cost of oil fuel per B.t.u. are as follows: (a) Increased efficiency of furnace and boiler; (b) reduced expense of boiler-room labor; (c) elimination of cost of ash removal; (d) facility of handling and storing; (e) smaller expense for upkeep; (f) more perfect control; (g) increased capacity; (h) usually less smoke. The actual monetary significance of these advantages will vary widely with the character and location of the plant.

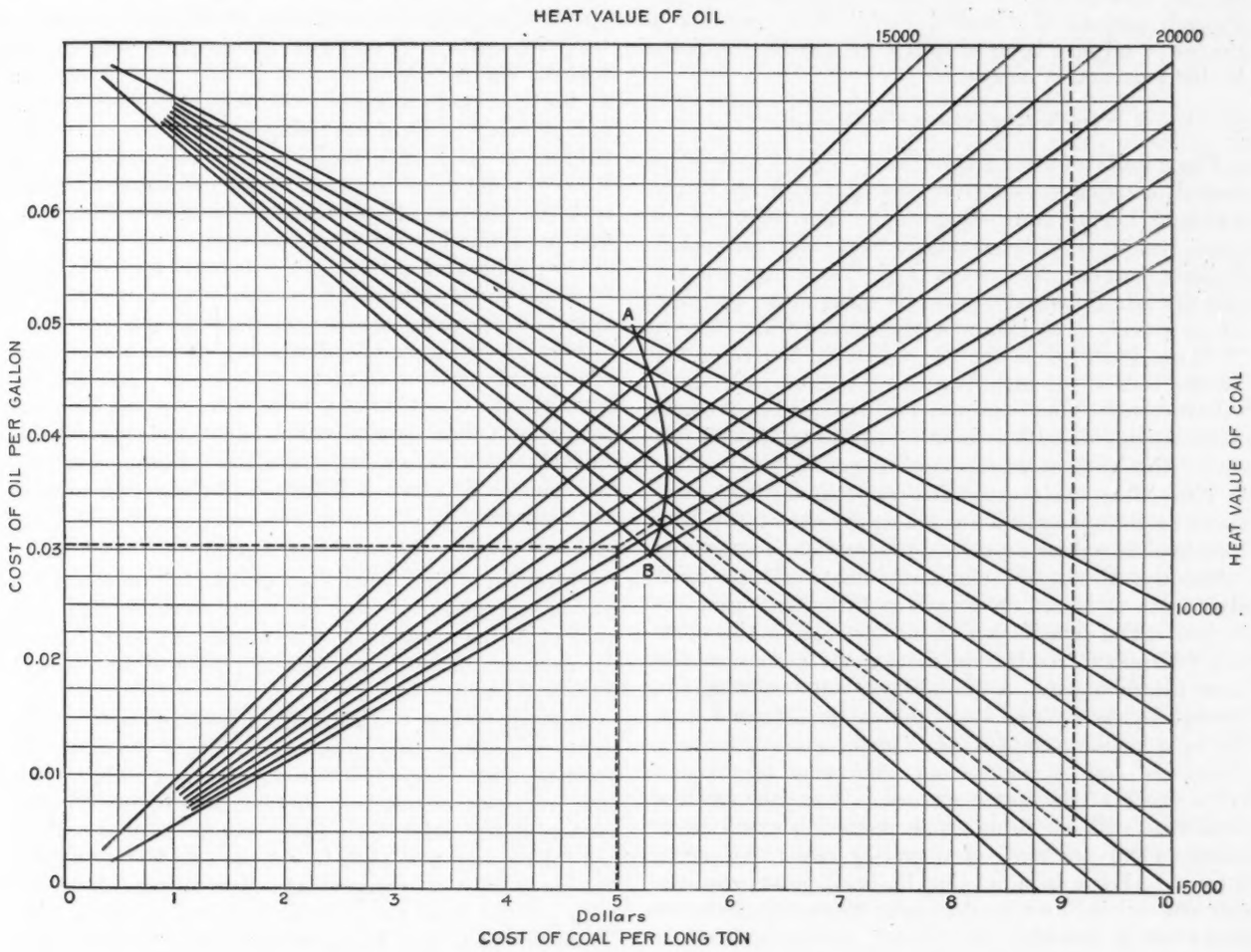

CHART TO DETERMINE RELATIVE COST OF COAL AND OIL FUEL

Regarding efficiency of furnace and boiler, it is to be noted that since it is possible to burn oil completely with very much less excess of air than is necessary with coal, the weight of chimney gas per thousand B.t.u. developed is smaller than with coal. This means a higher furnace temperature, more effective action of the heating surfaces and a smaller percentage loss to the stack. Gains from this source and from freedom from the loss of fuel through grates, etc., amount to appreciable saving under test conditions. If the advantages of restricting the air supply are to be made the most of,

*See also "Oil Fuel in New England," "Power," Dec. 19, 1916.

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long and deep furnaces, allowing ample combustion space, are necessary. Since very little draft is required to burn oil, tall stacks, designed for the combustion of coal, will tend to draw an unnecessary excess of air through the furnace and thereby reduce the possible economy, unless adequate control be established through an analysis of the chimney gases. Approximately 12 or 13 per cent. CO_2 in the flue gas corresponds to the condition of maximum efficiency. Smaller gains in economy are to be expected in plants where economizers are used, since with oil fuel, the weight of chimney gas, and hence the quantity of heat available to the economizer, is less than with coal.

Owing to the perfection of control with fuel oil, the possibility of adjusting furnace conditions more exactly to the requirements of the load, through peaks and through periods of "banked fires," the gains due to the use of oil may be considerably greater than indicated by the percentages mentioned.

Oil's Greater B.t.u. Value

The results of comparative tests of coal and oil on a small coasting steamer showed that for the given conditions 91 B.t.u. from oil gave the same effect as 100 B.t.u. from coal. The steamship "Nevadan" covered the distance between New York and San Diego on 2269 tons of coal. In traveling over the same course and using oil as a fuel, 9126 bbl. was consumed. This indicates 79 B.t.u. from oil as the equivalent of 100 from coal. Service tests of six months each on oil and coal, carried out on eleven of the Southern Pacific Co.'s bay steamers, showed about 75.5 B.t.u. from oil equivalent to 100 from coal. Similar tests on locomotives gave a ratio of 87.5 to 100. These tests would indicate that on the average about 84 B.t.u. from oil are the equivalent of 100 B.t.u. from coal in so far as service evaporation is concerned.

The use of oil fuel allows the labor bill for boiler attendance to be cut to about one-third that when coal is used. The substitution of oil for coal on the steamship "Nevadan" resulted in cutting the stokeroom crew from fifteen to six. A stationary plant operating four 500-hp. boilers reduced the fireroom force from four to one by a similar substitution. On the average for large plants the cost of boiler-room labor may be taken as 7.5 per cent. of the operating costs. It may be assumed, then, that with oil firing, boiler-room labor will be reduced to 2.5 per cent. of operating costs. Of course it must be borne in mind that in small plants requiring only one or two men in the boiler room, this reduction would not be possible.

Coal and Ash Handling Saving

The elimination of the cost of handling and removing ash will effect a further saving of about 3 per cent. of operating expense on the coal basis. The actual money value of the other advantages of oil fuel are so dependent on local conditions that no general estimate can be made.

Keeping the foregoing in mind, together with the fact that in coal-operated plants the cost of fuel amounts to from 40 to 70 per cent. of operating costs, we may estimate the excess price which may be paid for heat from oil over that from coal. For this purpose it is assumed that the average of the above figures, or 55 per cent., represents the fuel cost in the coal-operated plant. The items that will be considered as controlling are evaporative efficiency, boiler-room labor and the expense of ash removal.

In the coal-operated plant the following items of expense will occur for every $100 spent in operating: Fuel, $55; boiler-room labor, $7.50; ash handling and removing, $3; total, $65.50.

In the oil-operated plant 84 B.t.u. will do the work of 100 B.t.u. from coal. Consequently, at the same cost per B.t.u. the fuel expense will be only $0.84 \times \$55 = \$46.20$. The labor bill will be reduced to one-third its previous value, or to $2.50. The item involving ash will not appear. Hence, for the oil-operated plant we shall have: Fuel, $46.20; boiler-room labor, $2.50; ash, $0.00; total, $48.70.

This indicates that at the same price per B.t.u. for oil as for coal, $16.80 could be saved in every $100 of operating expense by substituting oil for coal. Evidently, then, the cost of oil could be increased by this amount without making the total cost greater than with coal; or the maximum amount which should be paid for oil out of every $100 of operating expense is $46.20 plus $16.80, or $63. The figure $46.20 assumed the same price per B.t.u. as for coal. The maximum allowable cost for oil fuel, then, would be $63.00 ÷ $46.20, or 136 per cent. that per B.t.u. for coal.

On the basis of the foregoing it would appear that oil fuel will result in operating economy up to a price per B.t.u. 36 per cent. in excess of that for coal.

As a ready means of determining the cost per gallon of oil fuel which will make the cost of operating the same as with coal at various prices per long ton, the chart here shown, has been prepared. The method of using this chart will be evident from the following example, the solution of which is indicated in the dotted lines on the diagram.

Use of the Chart

Example: Find what cost of fuel oil in cents per gallon will make the cost of power equal to that with coal at $5 per long ton. The heating value of the oil is taken as 18,200 B.t.u. per lb.; that of the coal as 14,000 B.t.u. per lb.

Method: Drop vertically from heating value 18,200 at the top of the chart to intersection with the horizontal from heating value 14,000 at the right. Follow oblique line from this intersection, upward toward the left-hand corner of the sheet until curve AB is reached. From the intersection with AB, follow the oblique line toward the lower left-hand corner of the page, to the intersection with vertical from the price of coal, $5, at the bottom. From this point pass horizontally to the left, intersecting the ordinate of oil prices at $0.0305 per gal.

The chart is constructed on the assumption that 36 per cent. more can be paid for B.t.u. from oil than from coal, in accordance with the results of the foregoing data. While this figure will be suitable under average conditions, in certain cases it may well happen that, owing to peculiarities of the plant or to unusual and predominating importance of some advantage such as cleanliness, nicety of control, etc., this figure should be modified. For example, one operator finds that 50 per cent. more can be paid for oil than for coal. In this case the results from the chart should be multiplied by the ratio of the substituted percentage to 36. This would give as a result to the problem, $0.0305 \times {}^{50}/_{36} = 0.0424$.

The Philadelphia Flotation Decision—II

Judge Woolley's decision in the appealed case of Minerals Separation against the Miami Copper Co. was commenced in last week's Journal. The remainder of the paper is here given.

The newly discovered phenomenon of the minute quantity of oil is not a chemical phenomenon. Oil in pulp in minute quantity if inert and left alone will do nothing and produce nothing. Something must be done to develop it. The phenomenon not being susceptible of development by chemical change, is developed by physical change of the pulp. As a medium or means of producing that change and creating the condition under which the phenomenon arises, the patentees pointed out—agitation.

The agitation of the patent does several things, old and new. It mixes the oil with the metal of the ore. This is old. Then by its greater intensity and longer duration it stirs the pulp into a froth, developing at once its own new use as a frothing means and still another new function of oil—that of a frothing agent. Both are new.

But froth is made of air as well as oil. Air in bubbles is used for its old function of assisting or escorting metal particles to the surface. But it is also used for the entirely novel purpose of supplying one of the essential elements of froth, froth being the new result intended.

Thus oil is used for its newly discovered characteristics of greater metal affinity when in minute quantity and for its new function as a frothing agent; air for the new purpose of supplying an element of froth; and agitation for its new purpose of bringing the two together and causing them to co-act and produce the new result of a metal-carrying froth. In other words, in so employing these old elements for new purposes, the new things which the patentees told the art are that a radical decrease of oil in conjunction with a radical increase of agitation, develops to its highest potentiality the known affinity of oil for metal and produces a physical change in the pulp in the form of a froth by which metal recoveries are made possible and commercially profitable. The importance of these disclosures, scientifically and commercially, is manifest.

In approaching a consideration of the scope of the patent, we lay aside those features of the discussion in which the plaintiff demands by broad construction the highest reward for a great contribution to a feeble art, and in which the defendant, contending for a narrow construction, emphasizes the servitude of a great art to a patent monopoly. The rights of an inventor and of an art in an invention are established by law and are not affected by other considerations. Speaking generally, the statutes give an inventor a patent monopoly of his invention to the extent of his patent disclosures, and to that extent the art is servient to his monopoly. Everything touching the invention not disclosed by the patent is free to the art without regard to the value of the inventor's contribution. So the question of law in this case, involving as it does large interests and perhaps far-reaching commercial results, is no different from similar questions constantly appearing in controversies of smaller compass. The question simply is whether certain practices come within the scope of the patent claims. But the question of infringement has grown far beyond the borders of the case and we are really asked both by the plaintiff and defendant to determine the scope of the patent in such terms as will inform the art as well as the owners of the patent the precise field covered by the patent and the extent of the field left free to the art. Such a decision to be useful must of course be predicated upon facts that make it legally possible, for otherwise we encounter the futility and the mischief of construing a patent in general terms and without reference to the occasion or thing which calls for its interpretation. To avoid this error we shall confine ourselves to the precise issues of this case as developed by the evidence, and without regard to other considerations we shall construe the patent with reference to the particular practices which are represented by one party to be within its scope and by the other to be beyond it.

The defendant practiced four processes of ore concentration, using in all the fomenting agent of oil in the critical proportion of the patent. Two processes were practiced before suit was instituted, the third during the progress of the trial, and the fourth after the record had been completed and the trial closed. As the infringement found by the decree relates to the processes appearing in the record, only those processes are before us on appeal.

Applications of the Processes

The defendant company owns and operates a large porphyry copper mine at Miami, Ariz. The ore is low-grade and peculiarly responsive to the process of the patent.

The defendant employed a metallurgical mining engineer to develop and install in its reduction works an oil-flotation concentration plant. The engineer made repeated visits to the mill of a neighboring copper company, a licensee of the plaintiff, studied the process of the patent there in practice, and reproduced it in the mill of the defendant. This was a small plant, of a capacity of but two tons per hour, or 48 tons per day, operated during the period from December, 1913, to Aug. 5, 1914. It was used evidently more as a testing or experimental plant for another process then being developed than for commercial purposes.

This constituted the defendant's first process, and as infringement was not disputed, we affirm without discussion that part of the decree holding infringement by this process.

On Aug. 7, 1914, two days after the discontinuance of the first process, the defendant started its second process in a plant which it had constructed during the practice of the first. This plant may best be understood by a diagram furnished by the defendant and by its own detailed description of its operation appearing in its brief:

> The material treated in the flotation plant at Miami is received through a launder or trough. This material is a freely flowing pulp, and flows into a box or tank. The oil or other modifying agent is supplied to the pulp through a pipe. A centrifugal pump raises the pulp from the sump and forces it upward through a pipe, from which the pulp passes into an inlet funnel. The pulp flows from the funnel downward through a pipe and enters the Pachuca tank through the side thereof. A small air pipe extends downwardly from the top of the Pachuca to a point near the bottom thereof, where it delivers an air jet. The small air pipe is surrounded by a larger pipe, open at both ends. There is an annular space between the two pipes, and the air entering the lower end of the large pipe through the small pipe permeates the pulp contained in the larger pipe with small bubbles, which have the effect of forming a mixture of air and pulp of lower specific gravity than the pulp alone. The lightened column of air and pulp rises and is projected against a conical deflector and then falls into the main body of the Pachuca. The circulatory movement of the pulp in the Pachuca tank has the effect of thoroughly

mixing the oil with the pulp. The pulp flows from the top of the Pachuca tank into a box, whence it is conducted by a launder or trough to the air cells.

The air cells are similar in construction. The bottom of each cell consists of four plies of canvas, beneath which are eight air compartments, separate and distinct from each other, extending in a series from end to end. The canvas bottom of the machine is inclined, thus making the cell deeper at one end than at the other, and it is for the purpose of getting an even distribution of air that the eight compartments are used, it being obvious that if there were a single air compartment most of the air would escape at the shallow end, where the water pressure is least. Air under slight pressure is supplied to the compartments beneath the cells, by means of a blower designated by the letter M upon the drawing. The air is conducted through an "air main" from the blower, and branch air pipes conduct the air to the several compartments beneath the cells. The degree of air pressure necessary is quite slight, and, as stated by Mr. Yerxa, it is necessary to use merely enough pressure to overcome the hydrostatic head of the pulp and to force the air through the permeable medium; that is, the canvas bottom.

The air so pumped beneath the canvas bottoms of the cells passes upward through the pores of the canvas into the pulp, and the bubbles rise through the pulp in a manner similar to the rising of the bubbles through a glass of carbonated water.

For the purpose of this discussion the details of the apparatus and of its operation may be simplified by referring to its four essential parts: *C*, centrifugal pump; *E* a break or open space between the pipe of the pump and the Pachuca tank, which does not appear in the defendant's account of the operation; *G*, Pachuca tank and its appliances; and Callow cells, considered as flotation apparatus.

Theory of the Process

Before following the steps or rather the flow of the defendant's process, we should have in mind the theory of its practice. The defendant maintains that the process of the patent is "an *agitation* froth process"; that is, a process by which the desired metal-bearing froth is obtained by agitating pulp containing the critical quantity of the frothing agent (oil) "to cause" the froth to arise or "until" a froth is formed. It says that its process, in contradistinction to the process of the patent, is a "*bubbles* process" (containing the same critical quantity of the same frothing agent) by which air, introduced into the pulp from below, passes through the pulp "without any agitation whatever," and arises to the surface in short-lived evanescent metal-bearing bubbles forming a "*foam.*" It maintains that by introducing air into the pulp by sub-aëration it produces a foam or froth otherwise than by agitation, that nowhere in the process is there agitation, or that, at most, there is only such agitation as appears in the prior art.

Agitation "to cause" a froth or agitation "until" a froth is formed, being the disclosed means of the patent to produce the phenomenon of the critical quantity of oil, and aëration without agitation being the defendant's claimed means of causing or obtaining the same phenomenon from the same critical proportion of oil in the form of an evanescent foam, the controversy revolves around the elements of aëration and agitation.

C. Centrifugal pump. The first step in the defendant's process was a centrifugal pump. The defendant claims its one function was that of lifting the pulp (containing oil in the critical proportion of the patent) from one floor of the mill to another, and that in doing so the pulp was neither agitated nor aërated. Opposed to this contention and to the testimony supporting it was testimony that a centrifugal pump drawing air and liquid was the most common type of agitator and aërator of the cyanide art before the Pachuca tank was invented; that in the defendant's apparatus, air was drawn with the liquid into the pump in large quantities; and that in revolving at the rate of 850 revolutions per minute the pulp was violently agitated and measurably aërated.

Reconciling the conflicting testimony as best we may, we are forced to the conclusion that the pump revolving at the rate of 14 revolutions per second could not well avoid agitating the liquid it hoisted; that the agitation was violent; that air was drawn in with the liquid and that to an extent the pulp was aërated within the sense of the agitation of the patent and also by the very mechanical means or its equivalent to which the defendant insists the patent is limited.

E. Break in the circuit. At the point *E* in the pipe between the pump and the Pachuca tank there was a break not appearing in the diagram, permitting the pulp, arising from the pump in its agitated and partially aërated state, to drop for a space through the air into a larger pipe, whence it was carried to the Pachuca tank. While this was not a prominent feature of the defendant's process it was of sufficient consequence for the defendant to use it. It had the effect of producing further agitation of the pulp in its fall and further aëration arising from that agitation. It was known as splash agitation, its principle appearing in the early attempts to purify water by aëration. We are satisfied that this constituted agitation and aëration by agitation, and again by mechanical means to which it is sought to limit the patent.

The Pachuca Tank

G. Pachuca tank. The pulp twice agitated and aërated was then carried without stopping into a Pachuca tank. This appliance, briefly described, is a tank 18 ft. 6 in. high by 4 ft. in diameter. Descending in its center are two pipes or columns, one within the other, and in operation compressed air is released through the inner one, sending the fluid in an upward current through the outer one until it strikes with force an overhanging cone or umbrella, which causes it to splash and fall back into the tank, to be subjected again and again to the same revolving movement for a period of time measured by minutes.

The Pachuca tank was taken from the cyanide art, where its one function was agitation and aëration, or rather aëration by agitation. Although agitation is denied by the defendant to be a part of its process, it cannot be seriously contended in the face of the testimony and of the demonstration of the action of the Pachuca tank before us, that the force of compressed air to which the pulp in the tank is subjected, does not cause agitation and very violent agitation.

But the defendant contends that the agitation of the patent is limited to agitation occasioned by mechanical means, and as the agitation in the Pachuca tank is caused by pneumatic means, it is beyond the scope of the patent. This contention is based not alone upon the words of the Supreme Court which we have already discussed, but upon the relation of a mechanical device to the discovery of the invention.

It appears that in the experiments in which the discovery was made, the inventors agitated various mixtures by an apparatus known as a Gabbett mixer, and when they came to reduce their discovery to invention and patent it, they illustrated diagrammatically "one form of apparatus suitable for carrying this invention into practice," which included such a mixer. The patentees did not attempt to patent a mechanical means by which their process could be practiced. This is obvious, for the means illustratively shown was a mechanism already

patented (No. 444,345, Gabbett mixer, 1891). Nor did they attempt or intend to limit their patent to any mechanical means. Their patent was for a process. But without regard to their intentions, did they in fact so limit it? That depends upon what they disclosed by their patent.

The Question of Agitation

By their disclosures they first told the art that a maximum metal recovery could be had from a minimum oil content. Up to the time of this disclosure that was an unknown phenomenon. But this disclosure alone, interesting as it was, would have been valueless to the art, and would not have entitled the discoverers to a patent, until they told how and by what medium that phenomenon could be brought into practical use. Knowing this, they then told the art by the same disclosures that the minute quantity of oil, besides possessing an affinity for metal, was a frothing agent, and when used as such the phenomenon appeared in the froth it developed. But the patentees did not stop with the disclosure that fomentation is the condition out of which the phenomenon arises, but proceeded by further disclosures to tell the art that the way to produce the desired fomentation is by agitating the pulp containing the frothing agent. But agitation of certain kinds for certain purposes was well known, so they went further and told what was not known, namely, that the agitation requisite to fomentation of the character desired, is agitation "greater than and different from that which had been resorted to before," that is, greater than the more or less brisk or vigorous test-tube agitation of early patents and of the Cattermole process, and different from the revolving gentle agitation of the Elmore bulk-oil process, and that it must be violent in character and extended in duration in order that air (the other element of fomentation) might be brought into the fluid and into co-action with the minute quantity of the frothing agent. They thus disclosed not only agitation but the kind of agitation as the medium or means by which the principle of their discovery could be reduced to practice. Agitation was thus made the practical element of their patented process, and by their patent disclosures they told the art that agitation was the secret by which the principle of their discovery could be unlocked and used.

If the same principle can be turned to use and the same results obtained without agitation, or by an agitation which is not the equivalent of the agitation of the patent disclosures, we may have another question; but when the critical quantity of oil is used and fomentation is produced by agitation, which in degree of violence and in duration is substantially that of the patent, clearly it is indifferent whether it is attained by mechanical or other means, for the patent deals with agitation as a means of developing the discovery, not with means for developing agitation.

Accepting the teaching of the patent with reference to agitation as a means, the defendant employed it, certainly in three, if not four, of the steps of its process. In the first and second, agitation was obtained by mechanical means; in the third (the Pachuca tank) by pneumatic means. It is upon this difference in means to produce agitation that the defendant, in part, defends the charge of infringement. But what it sought and what it got by the use of the Pachuca tank was agitation, and that is what the patent told it to get, and we conceive it makes no difference whether it got it by mechanical or pneumatic means. We see no difference between the blow of a paddle and the blow of a blast of air as means to produce agitation. And the defendant itself shows there is no difference between the two in procuring the agitation of the patent, for by agitating the pulp in the Pachuca tank by pneumatic means with an intensity and for a period of time sufficient to aërate the pulp, the defendant got the precise metal-bearing froth of the patent. This was unintentionally and accidentally shown on one occasion when the Pachuca tank was cut out of the process and the pulp brought to rest. The characteristic froth of the patent arose at once and formed in a collar two feet thick. In view of the agitation to which the pulp had been subjected, we must assume that it was the result of that agitation.

Thus far the defendant did everything that is disclosed by the process of the patent. It used the critical quantity of oil. This is admitted. It agitated the pulp by one means and another with an intensity and for a time sufficient to change the physical character of the pulp, as intended by the patent, and developed in it the quality of producing an air-bearing froth, which it did when permitted to come to rest. But in the practice of the defendant, agitation was not stopped or even arrested in the Pachuca tank. The pulp was carried in circuit without stopping and without abatement of agitation into Callow cells, carrying with it the air content accumulated by the agitation of the centrifugal pump, the air drop and the Pachuca tank.

The Callow Cell

Callow cells. As a last step, the pulp was conveyed into Callow cells. A Callow cell is a rectangular tank with a sloping bottom made of canvas, through the perforations of which compressed air ascends in myriads of air bubbles through the liquid it contains. By this process the defendant contends it pursued a practice taken from the prior art and entirely outside the scope of the patent.

In this connection much stress has been placed by the defendant upon the prior art, on the theory that as the Supreme Court found the invention not anticipated, all that the prior art contains is open to it without the hazard of infringement. This position is unobjectionable. It is clear that if the defendant practiced the process of the patent and obtained a different result, or if it practiced a different process and obtained the same result, it did not infringe. To do this it was free to resort to a practice of the prior art or to practice new to the art. It chose to rely upon a practice of the prior art, which, through producing the same result in metal recoveries as that of the patent, it maintains differed from it in its steps and means. It was based upon Patent No. 793,808 granted to Sulman and Picard (two of the patentees of the patent in suit) and commonly called the Bubbles patent. This patent, though it never reached the mill, has been extensively discussed by experts and counsel. Air is introduced into the bottom of a tank similar in shape to that of a Callow cell. Near the bottom is a perforated helical worm or tube through which, while revolving, air is permitted to escape and ascend in bubbles to the surface. As the pulp is modified by oil (not the critical quantity of the patent) the air bubbles and metal parti-

cles are coated with oil, whereupon the oil performs its known affinity for metal and air its known characteristic to ascend and assist the oiled metal to the surface.

While there is a similarity in principle between the mere introduction of air in the Callow cell and in the bubbles tank, the purpose for which air is injected and the function which air performs after it is injected are altogether different in the two. Before the pulp is put into the bubbles tank it is agitated for the purpose of mixing the oil and coating the metal particles, and when that is done it is turned into the bubbles tank where the air bubbles, liberated through the perforations of the coil, attach themselves to and escort the oil-coated metal particles to the surface, where they are carried off by skin flotation. In the Callow cell of the defendant's process, (the claimed equivalent of the bubbles tank) air was used for another purpose. The pulp first agitated to the potentiality of the critical quantity of oil and air of the patent was carried into the Callow cell, and with its elements thus fully developed was subjected to an air blast, which did two things, resulting in a third. First, the air blast further aërated or super-aërated an already fully aërated pulp by driving into it myriads of air bubbles, and second, caused an agitation which while considerable was not violent, resulting in a foam, which persisted so long as air pressure was maintained, and which had a metal-bearing quality and sufficient stability to permit recovery by overflow.

The Difference in Truths

A peculiar feature of this step in the process and upon which the defendant earnestly relies to distinguish it from that of the patent, is, that if the pulp agitation of the Callow cell is arrested by withdrawing the air pressure, the foam immediately subsides and the froth of the patent does not arise as it did when agitation was arrested in the Pachuca tank. This is true. It is equally true that in this fourth step, aëration is direct and is not the result of or caused by agitation. On the contrary, agitation results from aëration and such agitation, though present in some measure, is not even approximately of the violence and duration of the agitation of the patent. The operation in the Callow cell certainly possesses these distinguishing features from operation of the process where aëration is caused by agitation. Emphasizing this difference in its favor, the defendant pressed further and urged that the operation of the Callow cell was not dependent upon the precedent treatment of pulp in the Pachuca tank and that the same results could be obtained from the Callow cell without such previous agitation and aëration. This assertion is based upon an experiment made by the defendant in the presence of representatives of the plaintiff when the Pachuca tank was cut out of the system and pulp from the centrifugal pump was shunted directly into the Callow cells, with the result that the Callow cells continued to perform their function of supplying air bubbles, agitating the pulp to a degree and forming an overflowing metal-carrying foam. But the metal carried over was not assayed and we do not know what were the commercial results of the test. We know, however, that this was but an experiment and after the experiment had been concluded the defendant returned immediately to its practice of using the Pachuca tank. Nor are we informed as to what would happen if the centrifugal pump had also been cut out, because whether in the mill or in the laboratory, so far as we have been shown, it appears that *before* the Callow cell (or bubbles tank) is called upon to perform its task the pulp is always pre-agitated and pre-aërated in some fashion and to some extent. Even in the demonstrations of the Callow cell and the bubbles tank made before us in court, the defendant's demonstrator caused the pulp to be violently agitated by a *Gabbett mixer,* the illustrated means of the patent, for a period of time measured by a stop-watch before it was turned into the cell and tank.

Notwithstanding the defendant's testimony is silent as to what a Callow cell would do to pulp that had not been previously agitated and aërated, and notwithstanding all Callow cell demonstrations before us were made with pre-agitated and pre-aërated pulp, the case for the defendant was largely argued as though its process consisted solely in passing thoroughly mixed but quiescent pulp directly into Callow cells, where it received its first and final aëration without previous or present agitation, resulting in a metal-bearing foam with characteristics different from those of the froth of the patent. We find nothing in the evidence or in the demonstrations which justifies that argument. If the only agitation to which the pulp was subjected (after such agitation as in the prior art was necessary to mix the oil and ore) was the agitation of the Callow cells, we would not say that that agitation amounted to or was the equivalent of the violent agitation of the patent disclosure and constituted infringement; but in the process we are considering and upon which the decree we are reviewing was based, the Callow cells were not the whole process, but were merely the last of four distinct parts of the process, the other three being the process of the patent or its fair equivalent. Having used the process of the patent in the first three steps in developing in the pulp the potentiality of the critical quantity of oil and air and in bringing the pulp to the point where, if permitted, it would produce the result of the patent, we feel that the defendant cannot escape infringement by taking an additional step, even though that step if taken alone avoids the patent.

The Third Miami Process

The third process of the defendant was developed and put into practice during the trial and constituted one of the defenses to the charge of infringement. There is little difference between it and the second process.

The plant is shown to comprise two independent sets of flotation cells. The flotation cells are designated "roughing cells" and "cleaner cells." Adjoining each group of cells is a Pachuca tank. The operation begins upon the 22 concentrating tables, so numbered upon the drawing. The material rejected by these tables is treated by the flotation process. The flow of pulp in the tables through the launders takes place by gravity until the pulp reaches a bucket elevator, which is the substitute for the centrifugal pump in the second process. When the pulp is raised by the elevator to an upper floor, it is divided and flows in equal parts into two Pachuca tanks, thence to the Callow cells, where metal recoveries are obtained by froth overflow.

The value of this process, as a defense, is found in an experiment to which it was subjected. The plant was arranged in two groups of identical members. In the experiment one group was operated with the Pachuca tank as planned. In the other the Pachuca tank was cut

out and the pulp conveyed directly from the elevator to the cells. The result was no apparent difference in the action of the pulp and little difference in the assays of the metal recoveries, that difference, curiously enough, being in favor of the group in which the Pachuca tank was not used. The evidence of the fact and of the effect of this experiment was not contradicted, except, perhaps, by the defendant itself, by returning at once to its previous practice of using both Pachuca tanks, and in pursuing that practice to a time beyond the trial. This fact places the third process in the position of the second, where we have found that agitation and aëration of the Pachuca tank is the agitation of the patent and amounts to infringement.

The fourth process is not in the record and was not considered by the District Court in reaching the decree now before us on appeal. It was brought to our attention during the argument by counsel, who said that in the process developed by the defendant after the trial, and now practiced, the Pachuca tanks are eliminated, the pulp being delivered directly from the bucket elevators to the Callow cells. While we are loath to omit from our consideration and judgment anything affecting this very important patent and the art to which it relates, we feel, nevertheless, that we cannot consider and adjudge with propriety or authority a process with respect to which the plaintiff has had no opportunity to produce testimony and which was not embraced in the decree we are reviewing.

We find no error in the decree of the District Court holding valid and infringed claims 1 and 12 of the first patent in suit.

The Second Patent in Suit

The second patent involved in this suit, No. 962,678—also for improvements in ore concentration—was applied for on Apr. 30, 1909, was issued on June 28, 1910, to Sulman, Greenway and Higgins, and has not been judicially passed upon except by the court below. Its particular object is "to separate certain constituents of an ore such as metallic sulphides from other constituents such as gangue when the ore is suspended in a liquid such as water."

It is also an air-froth flotation process, but differs from the first patent, although both processes may be and both actually are, employed conjointly. Its essential feature is the use of a mineral-frothing agent in solution and the method will be best understood by turning to the specification:

According to this invention the crushed ore is mixed with water containing in solution a small percentage of a mineral-frothing agent (that is of one or more organic substances which enable metallic sulphides to float under conditions hereinafter specified) and containing also a small percentage of a suitable acid, such as sulphuric acid, and the mixture is thoroughly agitated; a gas is liberated in, generated in, or effectively introduced into the mixture and the ore particles come in contact with the gas and the result is that metallic sulphide particles float to the surface in the form of a froth or scum, and can thereafter be separated by any well-known means. Among the organic substances which in solution we have found suitable for use as mineral-frothing agents with certain ores are amyl acetate and other esters; phenol and its homologues; benzoic, valerianic and lactic acids; acetones and other ketones, such as camphor. In some cases a mixture of two such mineral-frothing agents gives a better result than a single agent. The above mentioned mineral-frothing agents are all more or less effective in the presence of an acid, such as sulphuric acid, and are given as types, but are not intended to form an exhaustive list of suitable organic substances which may be used in this manner and for these objects. On the other hand there are many organic compounds which in solution will not effect the result described, such as some sugars, dextrin, saponin, albumen, ox gall, etc., and a simple test is required in the case of varying ores or materials to determine which organic compound is most suitable.

The following is an example of one method of carrying this invention into effect. Water containing a small percentage of sulphuric acid in solution, say from 0.2% to 0.5%, and containing in solution a small quantity, say 0.1% of one of the foregoing organic substances (say amyl acetate) is, with finely pulverized ore, introduced into an agitating apparatus, in the proportion of say 3 parts by weight of water to 1 part by weight of ore. The agitation is carried out in such a way as thoroughly to disseminate air through the mixture, which is thereafter discharged into a spitzkasten. It is found that a coherent froth or scum floats on the surface of the water in the spitzkasten. This froth contains a large proportion of the metallic sulphides, but is substantially free from gangue. Any well-known means may be employed for collecting the froth. If desired the tailings can be re-treated by the same process with or without the addition of fresh quantities of the organic materials referred to. The action may in some instances be improved by heating the mixture. . . .

Several agitation vessels are placed in series. These may conveniently be large vats separated by partitions having opening at the bottom so that the liquid may pass from one to another. Each vessel is provided with a rotatable stirrer which is conveniently of the form shown in the drawing. Each stirrer is carried on a spindle rotated at a high speed by any convenient means. Crushed ore or similar finely divided mineral is fed into the first vessel through any convenient ore-feeding device, . . . and water is also fed into the vessel. A small proportion of acid, such as sulphuric acid, may be introduced into the water from the feeding vessel, and a small proportion of one or more other soluble substances which enable metallic sulphides to be floated by air under the conditions hereafter specified, may be introduced from the feeding vessel. The liquid containing ore in suspension is vigorously agitated in the agitation vessels and escapes at the outlet highly charged with air.

A settling apparatus consisting of one or more spitzkasten is placed immediately at the outlet from the agitation apparatus. As shown in the drawing, the spitzkasten has a launder to receive the floating froth which passes away through the outlet. The liquid and the sunken material pass out through the outlet at the bottom of the spitzkasten. The level of the liquid in the spitzkasten is slightly above the lip. Within the spitzkasten is placed an inclined baffle or guide plate, which may be made adjustable, extending upward from below the inlet and arranged to direct the stream of ore particles and air bubbles toward the surface of the liquid in the spitzkasten.

Hitherto many proposals have been made for the wet concentration of ores involving the addition to the liquid in which the ore is suspended of an immiscible liquid. For example, in the patent granted to Cattermole, Sulman and Picard, United States No. 777,274, dated Dec. 13, 1904, is described a process of ore concentration in which metalliferous particles were coated with a thin film of a fatty or resin acid or a phenol or a cresol by introducing the alkaline compounds of these materials into an acid liquid whereby these materials were liberated in an immiscible or insoluble condition and adhered to the mineral particles. In another known process the powdered ore suspended in water, preferably acidified, is mechanically brought to the surface whereby the particles are exposed to the air and it is found that the metalliferous particles float on the surface while the gangue sinks. In this known process the selective flotation of the metalliferous particles is not due to the metalliferous particles being coated with a selective agent, that is to say, the selective flotation is due to the properties of the metalliferous particles themselves when exposed to air or other gas and brought onto the edge or surface of water preferably acidified.

The present process differs from the two before-mentioned types and from other known concentration processes by the introduction into the acidified ore pulp of a small quantity of a mineral-frothing agent, i.e., an organic compound in solution of the kind above referred to and by the fact that the metalliferous particles are brought to the surface in the form of a froth or scum not by mechanical means, but by the attachment of air or other gas bubbles thereto.

In the frothing processes hitherto known the substance used to secure the formation of a mineral-bearing froth has been oil or an oily liquid immiscible with water. According to this invention the mineral-frothing agent consists of an organic compound contained in solution in the acidified water.

We do not confine ourselves to the proportions above given, the best proportion can in each case be easily determined by trial.

It is well known that certain of the organic substances we have referred to are not soluble in water in all proportions and that if used in excess might partly remain insoluble in the acidified water and might become mechanically affixed to the metalliferous particles of the ore. We disclaim any such use of these substances and only claim them in such amount as will enable them to dissolve in the acidified water.

The claims in issue are the following:

1. The herein described process of concentrating ores which consists in mixing the powdered ore with water containing in solution a small quantity of a mineral-frothing agent, agitating the mixture to form a froth and separating the froth.

2. The herein described process of concentrating ores which consists in mixing the powdered ore with water containing in solution a small quantity of an organic mineral-frothing agent, agitating the mixture to form a froth and separating the froth.

5. The herein described process of concentrating ores which consists in mixing the powdered ore with water containing in solution a small quantity of a mineral-frothing agent, agitating the mixture and beating air into it in a finely divided state so as to form froth and separating the froth.

6. The herein described process of concentrating ores which consists in mixing the powdered ore with water containing in solution a small quantity of an organic mineral-frothing agent, agitating the mixture and beating air into it in a finely divided state so as to form a froth and separating the froth.

The difference between the two patents may be shortly stated to be this: The first process rests upon the use in very small quantity of an oily substance that does not dissolve in water, coupled with agitation of the pulp, and this succeeds in producing a special froth that is remarkably effective in recovering the minute particles of ore. The second process does not employ oil, or an undissolvable substance; on the contrary, the "mineral-frothing

agent" must be in solution, and *ex vi termini* must therefore be dissolvable. The specification disclaims the use of so large a quantity that part of it remains undissolved. The "mineral-frothing agent" is further limited by describing it as "one or more organic substances which enable metallic sulphides to float under conditions hereinafter specified"; and, as this general statement does not convey specific information, the patentees give several examples of organic substances that are found to be suitable for use in solution. In passing we may note that claims 1 and 5 are broad enough to cover inorganic frothing agents also, but as no such agent is yet known this feature need not now be considered. Just how or why this solution with the needful agitation produces the froth, is not certainly known; but the fact is, that (to use the language of the brief)—

> . . . its effect (is) to produce a similar action of air bubbles in the attraction of metallic particles, a similar levitation of the metallic particles, a similar persistence of the bubbles, a similar reliable adherence of the air bubbles to the metallic particles, and a similar capacity for final separation of the metallic particles by their overflow, still in attachment to air bubbles, at the top of a vessel containing the pulp.

An observable difference in effect is that the froth of the second patent is composed of bubbles much smaller than the bubbles of the oil process.

We may also note that while the addition of an acid to the mineral-frothing agent is described as part of the process, this was at that time a usual practice, and in any event is not an element in the claims now in issue. The agitation is to be thorough, but in the same connection the means for bringing this about is described in terms that are wide and inclusive. The air or other gas is to be "liberated in, generated in, or effectively introduced into the mixture," in order that the ore particles may come into contact with the gas and as a result may float to the surface in the form of a froth or scum which can be separated afterward by any well known means. The object of introducing the air or other gas into the mixture is such agitation of the pulp as will produce the desired froth, but the claims are not confined to a particular device or a particular degree of agitation. But of course, the agitation must be thorough and it must be effective, these being matters for experiments but always with the ultimate object of bringing the sulphide particles to the surface and holding them there in the grasp of a froth.

We do not find it necessary to discuss the question of validity; our conclusion is, that the patent discloses invention and has not been anticipated. As in the case of the oil process, the patentees seems to have taken "the final step which converted experiment into solution, turned failure into success" (Minerals Separation Co. vs. Hyde, 242 U. S., 261); and we find nothing in the prior art that can be held to anticipate. The real question upon this patent also is the question of infringement, and here as well as there the decision turns upon the kind and degree of agitation employed by the defendant. We need not dwell upon the subject, for as the defendant used both processes conjointly it is evident that what has been said about the infringing agitation in the oil process must also apply to the same agitation when considered in reference to the second process. There is this difference, however; as pointed out above the agitation of the second process is so described as to cover expressly a wider range of means and degree that is expressly covered by the first process, and therefore needs less aid, if any, from the doctrine of equivalents. For the reasons given in discussing the oil patent, we think the defendant's practices infringe also the process now under consideration.

The third patent involved, No. 1,099,699—was applied for on June 30, 1911, was issued on June 9, 1914, to Henry Howard Greenway, and has not been judicially passed upon except by the court below. As stated in the specification, its process is "a modification of the invention described in U. S. Patent to H. L. Sulman, A. H. Higgins and myself, No. 962,678, granted June 28, 1910," which is the second patent here in suit. Greenway's particular object was "to separate certain constituents of the ore such as copper sulphides (for example in the form of copper pyrites or metallic copper, natural or reduced) from other constituents, such as gangue where the ore is suspended in a liquid such as water." After describing the process of No. 962,678, as one "applicable generally to the recovery of metallic sulphides and like floatable metalliferous matter and in case of lead and zinc sulphides to which the process has been largely applied" and stating that in such process "it is necessary for efficient working that the pulp should be lightly acidified, and in most cases in practice the pulp is heated," the patentee disclosed his discovery, namely, that both acids and heat can be dispensed with, saying that "it is now found that with copper ore such as an ore containing copper pyrites effective separation is obtained in the cold without the use of acid by employing as mineral frothing agents, aromatic hydroxy compounds such as phenol, cresol or mixtures containing the same." Upon this disclosure the claims here in issue were granted, illustrative of which claim 12 is for "a process of concentrating ores which consists in mixing a powdered ore containing copper with neutral water containing in solution a minute quantity of cresol, agitating the mixture in the cold to form a froth and separating the froth." In the court below the patent was held invalid, and agreeing as we do with the conclusion reached by it in reference to the first and second patents, we are the more inclined to follow its decree in reference to the third patent. But an examination of the proofs satisfies us that the process disclosed in this patent was a substantial departure from processes of the prior art. The heating of water is a matter of large moment in large operations, and the use of acid is a matter of constant and considerable expense. By wholly dispensing with both by the use of a minute quantity of hydroxy compounds, the patentee has disclosed an original and novel plan which has broadened and made more simple the agitation process of air flotation. The length of this opinion, rendered necessary in the full discussion of the first patent, is the sufficient warrant for our refraining from a detail discussion of the proofs and reasons which led to our conclusion as to the novelty and inventive character of Greenway's discovery, and we therefore limit ourselves to stating that after full consideration we have reached the conclusion that his patent is valid, and, for the reasons stated in discussing the first patent, is infringed.

It is ordered that the part of the decree of the District Court holding valid and infringed claims 1 and 12, and invalid claim 9, of Letters Patent No. 835,120, and holding valid and infringed claims 1, 2, 5 and 6 of Letters Patent No. 962,678, be affirmed, and that the part holding invalid claims 1 to 12 of Letters Patent No. 1,099,699, be reversed; and that a decree in accordance with this opinion be entered.

The Determination of Silica

By H. A. B. Motherwell*

The determination of silica in ordinary analysis has been the subject of considerable investigation. F. G. Hawley, in the *Journal* of Mar. 31, 1917, points out a lead that other chemists might well follow. This is not Mr. Hawley's first article on a similar subject, and the endeavor to give others the benefit of one's research is highly praiseworthy. Eighteen months ago I was associated with Mr. Hawley in some silica research work, and I have since carried on further investigations.

Solubility of SiO_2 in Chloride Solutions

While all chemists who have done check work in SiO_2 determinations readily concede that it is soluble, few seem to realize the degree of solubility and still fewer have investigated the cause.

The paper by Lenher and Truog in the *Journal of the American Chemical Society* for May, 1916, contains the fullest details yet published of such investigations. At that date an average of 10 to 15 SiO_2 determinations in duplicate was being made daily on check work at the laboratory of the International Smeltery, at Miami, Ariz., and no correction was made on the weight of SiO_2 found. Scores of experiments had proved that on the average the loss from solubility was just conterbalanced by the gain from impurity in the flux. Since that date I have worked in a laboratory where the idea of gain from flux was scouted and no deduction made; but a correction was made for SiO_2 dissolved, according to the amount of it found. The amount to be added varied from 0.4% on samples under 5% up to 1.6% on samples over 50% in SiO_2. The idea was entirely wrong, as is shown by Mr. Hawley's figures and those given herewith.

SILICA DETERMINATIONS ON SLAG SAMPLES

No.	Fusion	Dehydrated Silica Taken Up	On Filter, %	In Filtrate, %
1	Peroxide	10 c.c. HCl (50%) boil 2 min.	39.52	0.0030-0.60
2	Peroxide	10 c.c. HCl 25 c.c. water boil 2 min.	38.10	0.0065-1.30
3	Peroxide	25 c.c. HCl 50 c.c. water boil 2 min.	37.32	0.0132-2.64
4	Peroxide	25 c.c. HCl 100 c.c. water boil 2 min.	37.20	0.0146-2.92
5	NaOH	As No. 1	39.36	0.0036-0.72
6	NaOH	As No. 2	338.20	0.0070-1.40
7	Peroxide and NaOH	As No. 1	35.20	0.0030-0.60
8	Peroxide and NaOH	As No. 4	33.40	0.0115-2.30

Determinations similar to Nos. 1-6 but run in pairs on concentrates instead of slag, gave results all within 14.15% to 14.25%. Determinations similar to Nos. 7 and 8, run as No. 4, but on concentrates, give 12.8%. No corrections have been included in any of these results. According to the scale referred to, the correction in the case of No. 8 would be 0.8%, making a total of 13.6% SiO_2. The umpire in New York reported this sample as 14.1% SiO_2.

Another sample of slag assayed at three large smelteries by independent chemists gave the following results:

SAMPLE ANALYZED AT DIFFERENT PLANTS

Sample	Dehydrated SiO_2 Taken Up	Correction Made	$\%SiO_2$
A	Details not known	Details not known	38.7
B	Details not known	Details not known	39.0
C	25 c.c. HCl and 50 c.c. water	Included in result	39.38
D	According to Hawley	None	39.62
D	According to Hawley	None	39.62
D	According to Hawley	None	39.70

Referring to Mr. Hawley's table No. 2 in the article previously mentioned we note that the SiO_2 recovered from the filtrate varies little, and not in proportion to the SiO_2 present in the sample.

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Of the total SiO_2 found, that in the filtrate amounts to the following per cent.

1	2	3	4	5	6	7
0.39	0.45	1.05	2.10	3.66	6.83	10.25

showing that the SiO_2 loss increases with the amount of SiO_2 present in the sample.

If from the weight of SiO_2 found in each of the seven analyses we deduct 1 mg. as impurity introduced by flux, express the result as per cent. and add to it the per cent. SiO_2 recovered from the filtrate, all the results will agree within the limits allowable in technical work. Of course no one would work on 20 mg. for SiO_2 estimation.

Lenher and Truog instance the solvent effects of sodium and ammonium chlorides. The following figures show that the loss of SiO_2 is largely due to the presence of salts in the solution. In these tests the dehydrated SiO_2 was taken up with acid, filtered and washed, then rinsed off the filter into clean casseroles and evaporated to dryness. After treatment as shown, the SiO_2 that dissolved was estimated.

The time of boiling and water added were the same in every test.

EFFECT OF THE PRESENCE OF SALTS ON SiO_2 DETERMINATION

No.	Acid and Salts Added to SiO_2	Mg. SiO_2 in Filter
1	SiO_2 + 10 c.c. HCl	0.8
2	SiO_2 + 10 c.c. HCl	1.0
3	SiO_2 + 10 c.c. HCl + 1 g. $MgCl_2$	2.2
4	SiO_2 + 10 c.c. HCl + 1 g. $MgCl_2$	1.8
5	SiO_2 + 10 c.c. HCl + 1g. each $FeSO_4$, $CuSO_4$, $Al_2(SO_4)_3$	2.0
6	SiO_2 + 10 c.c. HCl + 5 g. NaCl	4.0
7	SiO_2 + 10 c.c. HCl + 2 g. $CaCl_2$	1.2
8	SiO_2 + 10 c.c. HCl and continued boiling	1.8
9	SiO_2 + 10 c.c. HCl + 2 g. $MgCl_2$	3.5
10	SiO_2 + 10 c.c. HCl + 5 g. NaCl	3.5

These results seem to indicate that the more alkali salts there are present the greater will be the loss of SiO_2. Hence the time of boiling and the volume of liquid must be kept to a minimum, which will cause a maximum amount of the NaCl to remain undissolved until the wash water is applied to the filter.

Caustic Soda Fusions

If Na_2O_2 is not available and material carrying much copper or lead is to be run, necessitating acid treatment before fusion in a platinum crucible with $NaKCO_3$, time will be saved by making fusions in nickel crucible with NaOH alone. Break off about 1 in. (5 g.) of pure stick NaOH. Put into a 30 c.c. nickel crucible and fuse in a dull-red muffle. Remove and allow to cool. Weigh in 0.5 g. of sample and fuse in muffle. It is always advisable to use a cover with straight NaOH fusions, as there is much more boiling and chance of loss than with Na_2O_2 mixture. When fused, remove the nickel cover, pick up the crucible by the edge with a pair of finger tongs, give a swirl and pour out the contents quickly onto a slab of smooth iron or copper.

While the crucible is cooling keep it turning so as to form the thinnest possible layer inside with that portion of the melt that did not come out. The smallest part of the melt collected in a lump is very slow to dissolve. Place the crucible and lid in a 4-in. casserole. Fill the crucible half full of warm water, then almost fill with HCl. With a finger cot scrub out the crucible and wash down the lid. Remove both. Add the poured melt and cover with a large clock glass. Warm to dissolve, then add a few cubic centimeters of nitric acid to oxidize and proceed with evaporation and remainder of treatment as usual for correct SiO_2 work.

On a series of trials over several months on a variety of materials such as slags containing 35-40% SiO_2, calcines with 20-24% SiO_2 and concentrates with 14-18% SiO_2, I have found that, when making no correction on weight of SiO_2 obtained, the NaOH fusion result is always about 0.3% higher than that from Na_2O_2 mixture. Investigation showed that the impurity in the Na_2O_2 mixture came from the NaOH. In this fusion about 2 g. NaOH will be used, whereas in straight caustic fusion about 5 g. will be used, so that the gain from flux will be greater than the loss due to solubility of SiO_2. After five or six thousand Na_2O_2 fusions in nickel crucibles with some hundreds checked by the carbonate method in a platinum crucible I can speak for the accuracy and the speed of the former method.

Regarding direct fusions on limerock, there is a possible source of loss that is purely mechanical. The first water is added to the fusion from a fine jet inserted under the cover glass. When the action is over, the glass is removed and the HCl added in small lots from a burette, beginning with weak acid. A fine spray that is scarcely visible will dance above the crucible to a height of two or three inches. Some of it will fall beyond the sides of the casserole in which the crucible stands, so that it may be seen on the bench.

Using the Government standard argillaceous limerock and running one check every other day in a lot of 20 samples, for some time results were obtained lower than the SiO_2 content given by the Government analysis. The assumption was that all the work of the operator was proportionately low. When the loss from spray was stopped, the results agreed closely with the correct figure.

The following figures are the results of a few of many experiments to learn the effect of the presence of various metals on SiO_2 determination. Half a gram of the sample was fused in a nickel crucible with Na_2O_2 mixture, extracted by HCl, dehydrated, and taken up with 10 c.c 50% HCl. This was boiled one minute, 20 c.c water added, warmed and filtered.

EFFECT OF METALS ON THE DETERMINATION OF SiO_2

No.	Sample	Metal Added	SiO_2 Found %
A. 1	Concentrates		14.40
2	Concentrates	100 mg. As_2O_5 in fusion	14.40
3	Concentrates	10 mg. Sb in fusion	14.40
4	Concentrates	100 mg. Sb in fusion	14.50
5	Concentrates	50 mg. MoO_3 in fusion	14.35
6	Concentrates	100 mg. MoO_3 in fusion	14.40
7	Concentrates	200 mg. MoO_3 in fusion	14.40
8	Concentrates	30 mg. V_2O_5 in fusion	14.40
9	Concentrates	50 mg. V_2O_5 in fusion	14.40
10	Concentrates	15 mg. Bi as nitrate to sol. of "melt"	14.50
11	Concentrates	50 mg. Pb $(NO_3)_2$ sol. of "melt"	14.50
12	Concentrates	50 mg. Pb $(NO_3)_2$ in fusion	14.50
13	Concentrates	30 mg. WO_3 in fusion	16.90
B. 1	Concentrates		15.20
2	Concentrates	50 mg. $PbSO_4$ in fusion	15.20
3	Concentrates	250 mg. $PbSO_4$ in fusion	15.50
4	Concentrates	300 mg. MoO_3 in fusion	15.30
5	Concentrates	300 mg. MoO_3 in HCl solution	15.30
6	Concentrates	50 mg. WO_3 in fusion	19.40
7	Concentrates	100 mg. $BaCl_2$ in fusion	38.00
8	Concentrates	100 mg. $BaCl_2$ in HCl solution	38.00
9	Concentrates	20 mg. TiO_2 in fusion	15.20
10	Concentrates	100 mg. TiO_2 in fusion	15.60
11	Concentrates	100 mg. TiO_2 in fusion	15.80
C. 1	Siliceous ores		66.6
2	Siliceous ores	$BaCl_2$ added to fusion	68.6
3	Siliceous ores	$BaCl_2$ added to solution of melt	68.8

From these results it is deduced that As, Sb, Pb, Bi, Mo and V do not interfere with the SiO_2. Lead, even when added as sulphate does not remain with the SiO_2 unless in very large quantity. Tungsten is left with the SiO_2. All the Ba in samples "B. Nos. 7 and 8" was left with the SiO_2. These samples carried 20% sulphur. Samples "C. Nos 2 and 3" contained less than 1% sulphur. Some Ba was found in the SiO_2, but most of it went into the filtrate.

Titanium in small amounts does not interfere. In larger quantities it will depend much on the thoroughness of the washing. Most writers and authorities state that TiO_2, or the most of it, is left with the SiO_2. A very long series of tests has satisfied me that this is not so with all ordinary amounts. In many analyses on the following classes of material the SiO_2 after weighing was tested for TiO_2 and none found.

TESTING SiO_2 FOR TiO_2

Sample	% SiO_2	% TiO_2
Concentrates	15–19.0	0.7–2.0
Silica ore	70.0	0.3
Table concentrates	22.0	Up to 2.0
Argillaceous limerock	18.15	0.22

In the last sample the SiO_2 results checked almost exactly with the Government analysis and the TiO_2 obtained from the filtrate was 0.23% by calorimetric assay. Tests for TiO_2 were made in two ways: Ignited SiO_2 was fused with $KHSO_4$ in porcelain or platinum, extracted by 10% H_2SO_4 and tested by Na_2O_2; ignited SiO_2 was treated in platinum with HF and H_2SO_4 and evaporated to fumes twice to insure all HF being off, placed in muffle and then fused with $KHSO_4$ and tested.

Analysis of a sample of magnetite with 8% TiO_2 showed only a trace of TiO_2 in the SiO_2. It is evident to me that these small amounts do not interfere when the SiO_2 estimation is properly conducted.

I trust that this will cause other chemists to give us the results of research work in the ordinary daily routine of a works' chemist.

Zinc Smelting in Japan

According to United States consular reports, the zinc-smelting industry in Japan has made great strides since the outbreak of the war. Japan has become an exporting country. Whether the situation can be maintained after the restoration of peace it is not possible at present to foretell definitely. This question is now being considered.

The ores are obtained chiefly in Australia, China and eastern Russia. The mines in China, up to the outbreak of the war, were in the hands of Germans, but since then the contracts have been canceled, so that, if a certain amount of capital is invested, the foundations of Japanese trade can be made firmer. Japan alone cannot undertake the investments in these mines, and some coöperation is necessary. This should be sought in the United States, and both nations must see that some agreement is made concerning the mines of China and Russia. No doubt Japan has increased her assets since the war began, but when her property is compared with that of other nations it does not amount to much.

Calcium Carbide in Brazil

According to the annual report of the Companhia Brazileira Carbureto de Calcio established in the City of Palmyra, Minas Geraes, a note of which appears in *Commerce Reports*, the production of calcium carbide by this company during the year 1916 was 61,016 drums, as against 50,146 for the previous year. The board of managers calls attention to the fact that not only is the product well received in Brazil, but that considerable quantities have also been exported to Argentina.

Credits in South America

By Mark R. Lamb*

The problem of credits in South America is not nearly so difficult as would appear at first glance. It is true that there is no rating company that corresponds to our Dun and Bradstreet, but this is not altogether an unmixed evil. It is not difficult, nor does it take very long, to obtain definite information on the financial standing and credit of prospective clients in South America.

It is best to consult first your local banker in the district where the customer is. This banker, by the way, is much more willing to give such information than is your banker in the States. Bankers in South America have one officer, the manager, who knows everyone in his district. In order to assist you to visualize this state of affairs, imagine a single bank in every large building in New York City, each one doing business only with the tenants of that building. If to this is added that most of the tenants are related to one another, you have the usual condition in all but a few of the largest cities of South America. It will be seen that the bankers are likely to have accurate information concerning the business men of their districts, and it is probably for this reason that the commercial agencies have not made more headway and that their reports are usually not up to the mark set here in New York.

But there is also another reason. The average South American business man considers the questions asked by the commercial agencies as being in the nature of insults—until they are explained to him. The usual inquiry blank explains nothing and asks some questions in what is certainly a cold-blooded way. I was with a mine manager in Bolivia when he received such a blank for the first time. Among other things it asked if the directors were honorable and if they paid their debts? At first I thought my freind was going to have on "attack," but finally he succeeded in expressing his opinion of "American impudence."

The first inquiry should always be verbal and should be accompanied with a thorough explanation of our system. After the reason for, and value of, such a record in the States was explained to him, this manager was only too glad to give the desired information, since both he himself and his directors stand very high.

Another thing that prevents prompt service on the part of the commercial reporters is the manner in which their information is collected. One commercial company sent me a business directory that they had compiled of Santiago of ten years ago, asking that I go over it and correct it, giving rating, kind of business and amount of turnover of the important business houses of Santiago, and offering to pay ten dollars for this work! Ten thousand dollars would about pay the expenses of such a task.

Again, a New York commercial company will write twenty brief, impersonal demands for information to a bank manager with whom it has no relations and from whom it has no right to expect favors. The said bank manager is good to his business friends when they require information, but the informal and high-handed inquiries from here generally reach the waste basket by the shortest route.

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The conversation accompanying a verbal inquiry usually runs something like the following:

"Don Luis, a customer of mine, Sr. Aguirre, asks for a credit of $4000 on a purchase," I say to the manager. His reply is simple, brief and plain: "Sr. Aguirre is good for anything he undertakes," or "Sr. Aguirre has plenty of money, but you should have a clear understanding and a written contract with him," or "Sr. Aguirre is a millionaire, but you should get cash." Such information is not as detailed as one gets here, but it is just as useful.

I have been on the West Coast for a number of years, covering Peru, Bolivia and Chili and am glad to report that during that time my employers lost not a single account. While this is to be credited partly to the information supplied us by the banks, it is due mainly to the sound training and high sense of honor among the West Coast men of business, without regard to nationality. I will be glad at any time to supply any information I may have along these lines, feeling sure that it will promote good understanding and therefore increase business interchange.

The North American, in discussing or thinking of South American credit, assumes the attitude, unconsciously perhaps, that the credit, motives and procedures of American manufacturers, exporters, buyers and bankers is beyond reproach. It is therefore my patriotic duty to permit a glimpse of the other side. As this is a dangerous thing to do, only such cases as are known personally will be referred to, and in the briefest terms.

Case 1. An ore-purchasing company in New York bought antimony ore at a low price. The seller was late in delivering but the buyer accepted, sold the antimony and asked for more. When the price of antimony dropped, the buyer refused to pay for the metal accepted and sold.

Case 2. An ore-purchasing company in New York contracted for wolfram in specified minimum monthly lots. When the price of the metal dropped, the buyer refused to accept the final lot and has not even paid for the metal accepted and does not reply to letters and telegrams.

Case 3. A New York bank cabled to an ore buyer in South America a "confirmed credit," in favor of an ore-purchasing company in New York and, on the strength of the bank's cable, the buyer in South America bought sufficient wolfram to supply the American purchaser's requirements. Before final payment was made, however, the New York bank canceled the "confirmed credit"—a thing unheard of in South American banking circles.

Case 4. An American exporting company delivered cases supposed to contain 62% dynamite, but containing actually coal dust and dirt.

Case 5. An American coal shipper sells anthracite for producer-gas engines in Bolivia, guaranteed to be hand-picked with special care. This coal contains, by actual weight, 11% of clean slate, not counting pieces part coal and part slate. When it is realized that anthracite is worth as much as $60 per ton in some parts of Bolivia, the seriousness of such methods is apparent.

You ask what is done by the injured party—why does he not bring suit? There are very few Bolivians or Chileans who would attempt to bring suit in the States; just as you would hesitate a long time before bringing a suit

in Chili, and it is only occasionally that such a trick is played on—let us say—an English company with the inclination to fight.

The average Latin American thus cheated merely nurses his grudge and is a walking advertisement for Americans—as he views them.

Some of these cases are due, as the lawyer of one of the above companies naively explained, to "the desire of a subordinate to cover up a loss." At other times it is simply negligence or bad system, but in most cases it is apparently sharp practice, pure and simple. The lesson to be gained from it is that, whatever the reason for the apparent bad faith, the damage done by a thoughtless or frightened employee or a "sharp" lawyer is always infinitely more than the money "saved."

After years in South America I feel safe in saying that unfair complaints are so exceedingly rare that a good businesslike and profitable slogan for American exporters is a paraphrase and amplification of one that stares at you in the subway: "The customer is always right if he really thinks he is, even when he is wrong, but especially when there is any doubt."

Improvement in Duplex Steel

A patent has been granted, covering an improvement in the duplex process of making steel. It is said that mills have had considerable difficulty in making rolled shapes from duplex steel without seams or cracks. The cause of these defects is said to be the lack of managanese in the openhearth charge, the original manganese content having been practically eliminated in the converter early in the blow. The charge in the furnace contains, as a result, a trace to 0.05% manganese. This permits the formation of iron oxide, which will enter the bath, destroying to a certain extent the good rolling qualities of the ingots cast from it.

The patent improvement lies in keeping enough manganese oxide in the charge throughout the refining process, additions of manganese materials, preferably ore, being introduced into the furnace either before or with the charge. Thus the manganese is allowed to enter the metal so that the latter during the refining period will contain about 0.18% manganese or, better, 0.20% and over. To do this the furnace slag must contain at least 10% manganese oxide.

Placer and Lode Claims Defined

By Arthur L. H. Street*

"The term 'placer claim,' as I understand it," said Judge Riner of the United States District Court for the district of Wyoming the other day, in handing down a decision in the case of United States vs. Ohio Oil Co., 240 Federal Reporter, 996, "means ground that includes valuable deposits not in place; while by the terms 'veins' or 'lode,' as used in the statute, are meant lines or aggregations of mineral embedded in quartz or other rock in place."

In this case, in which the Government unsuccessfully sued to obtain a decree declaring withdrawal of certain lands from mineral exploration, Judge Riner reaffirmed the principles of mining law that there can be no valid location of a mining claim without actual discovery of mineral on the ground, and that finding of mere indications of the presence of minerals is insufficient to constitute such "discovery" as will support a location. But the court found, as a matter of fact, that in this case a valid discovery had been made.

Speaking of the character of minerals that must be discovered, the court adds that they "must be of such character that a person of ordinary prudence would be justified in further expenditure of his labor and means with a reasonable prospect of success in developing a valuable mine or, if it be oil, oil in commercial quantites."

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Hungarian Mineral Statistics

The following figures of Hungarian mineral production for 1914, which are somewhat belated, are given in a recent issue of *Iron and Coal Trades Review*: Copper, 358 tons; lead, 1368; iron ore, 1,722,340; pyrites, 102,370; manganese ore, 11,413; coal (excluding coke and briquets), 909,882; lignite (excluding coke and briquets), 7,902,240; briquets, 112,040; coke, 128,118; pig iron, 494,441 tons. There was a decrease from the 1913 production in the case of every article except lead, which showed an increase of 231 tons.

Imports in 1914 were as follows: Coal, 2,872,577 tons; lignite, 275,748; coke, 594,898; briquets, 11,712; pig iron (including ferroalloys), 94,438 tons.

Peruvian Ore Exports

According to *Commerce Reports,* of the U. S. Department of Commerce, certain ores were exported from Peru to the United States in 1916 as follows: Tungsten, 529,636 kg.; vanadium, 2,915.5 metric tons; molybdenum, 4,412 kg.; antimony, 63,038 kg. The tungsten exported was largely of 62% concentrates; molybdenum, about 90%; and antimony, 58%.

There are no available official statistics showing the total exportation of these minerals during 1916, but nearly all were exported to the United States, and, therefore, the figures represent practically the total quantity.

Preservation of Paper Notices

Blueprints or other paper notices, signs or warnings, pasted on a wooden back for support and given about three coats of ordinary shellac, such as is used by electricians, make a very satisfactory waterproof sign that will successfully withstand average rainy weather for a long time.

This type of sign, not requiring a glass front, does away with the item of glass breakage caused by accidents, small boys, wind, etc., besides being of cheaper first cost both in materials and construction.

Wolfram Output of Siam increased from 602,267 lb. in the fiscal year 1915 to 950,400 lb. in 1916, the entire amount having been mined in the district of Nakawn Sritamarat, in the Siamese Malay States, where the producing area has also increased, and with the present high prices a still larger output may be anticipated. In the district of Trang, in the same states, tungstate of calcium has been found and is now being worked for on a small scale.

The Labor Trouble at Butte

BUTTE CORRESPONDENCE

While there is evidence that Butte's new labor troubles, which were precipitated by the disastrous fire in the North Butte mine in which 161 men lost their lives, are being financed and encouraged by pro-Germans, there are several causes that lie deeper than anything that has recently occurred to bring them about. Every since the riots of 1914 when the old Moyer-ridden miners' union was disrupted, there has been growing evidence of the need of organization and authority to represent the miners in numerous grievances that have constantly arisen, as there has been growing evidence of overbearing authority on the part of petty bosses and a grinding of unprotected miners. Whatever the virtues of the big company, it is a fact well known to the large majority of people of Butte that its affairs in relation to the public and its vast army of employees have been misconducted, and it is regarded as a crime to say so. The great fault lies in the fact that the company managers are not in close touch with the public or with their employees. They employ a large number of spies and special agents to keep them informed, and the information the managers get is just such information as the agents think the managers want, and while the public knows a lot of things, the company managers think they know others.

The miners in the present uprising charge that the newspapers of Butte are owned or controlled by the Anaconda company and that only matter antagonistic to the miners is published; that they cannot get a hearing in the local press, nor get space for the most ordinary statements of their side. It is probable that not a newspaper man in Butte, if he is interested, would care to take issue with the miners on that question. It is not hard to imagine what sort of permanent feeling that policy must breed.

It is charged even that eastern financial and mining journals, are similarly influenced in favor of the big corporations, and that nothing is, or can be, printed that is not entirely favorable to them. Here is a statement that has been issued by the publicity committee of strikers, and which they could not get published in Butte:

Butte, Montana, June 12, 1917.

To the Public and All Members of Organized Labor:

The Metal Mine Workers Union recently organized in Butte, in addressing this communication to you feels that it is one of the duties our organization owes to workers in every branch of industry. In the first place a brief statement of conditions here in Butte will do much toward laying a proper foundation for the explanation of the purposes and aims of our organization.

There has been no organization for miners in Butte for the past three years and while we waited, confidently hoping at first that in time some organization would be perfected, we were finally driven to the conclusion that if we were ever to have an organization, we must develop and perfect it ourselves.

The task seemed too stupendous to even contemplate. We were and are opposed by the all powerful Anaconda Copper Mining Co., which has dominated and terrorized the State of Montana for years, ruthlessly and brutally crushing all opposition.

Experience has taught us that the police force, the county authorities, and in short almost every official agency, would be used in the attempt to extinguish the spark of resistance; but conditions finally became so acute that in desperation we organized, and in defense of all that is sacred to free-born men, by the love we bear to our families, we will fight to the bitter end, determined to look one another squarely in the eyes as free men should or force the companies to shackle us so thoroughly as to demonstrate finally that miners have no right to organize.

In this the largest mining camp on earth are gathered as avaricious, subservient and insatiable a group of business men as could be assembled any place on earth. Whenever wages are raised in the slightest degree, food, clothing, rent, fuel, etc. are immediately boosted so that not a vestige of gain shall remain to the man who earns it. Rent for example has practically doubled in the past two years, choice cuts of meat are indeed a luxury that workingmen can seldom afford, potatoes for which framers within fifty miles of Butte are paid from one to two dollars per hundred are sold in Butte for five dollars and even higher. Everything we buy is exorbitantly high, therefore our wages are not sufficient to provide us with the necessaries of life, yet when we attempt to voice a protest, the daily papers without exception, write, denouncing us as anarchists, I. W. Ws., etc.

Of course the fact that the papers are controlled by the companies, explains this attitude. We have no press and no facilities for exchanging our opinions except by word of mouth.

In the mines conditions are fearful. Bulkheads of solid concrete block a great number of the emergency exits and in most of the mines there are no exits at all on the lower levels. This is made possible by the criminal complaisance of the State Mining Inspector who never inspects a mine until after an accident and then only to report that the deceased miner came to his death through an unavoidable accident in spite of everything the company could do, a report generally rendered.

The companies have instituted a most infamous rustling-card system and have gradually perfected it until at the present time a man dare not express his opinion on any subject for fear he will be refused a rustling card. It is the most humiliating, degrading method, ever devised to break a man's spirit. If we can accomplish nothing more than the complete, unconditional abolition of the rustling-card system, we feel that we will have rendered the working class a great service, and this organization will fight it out on these lines, no matter what may come.

We anticipate vicious opposition and our effort has been to forestall as far as possible the more obvious attack, by turning the glare of publicity into places where the companies do not want light thrown, realizing that the slightest mistake might prove fatal and knowing that the companies had hordes of gun men around the mines to arrest and if necessary to kill our pickets, we decided that picketing was not necessary as the miners realize that our cause is just.

Our members understand that it is our business to see that no detectives or stool pigeons be given the opportunity to create a disturbance and the result has been that to date the companies have been absolutely unable to start trouble. A number of our members have been arrested, but the organization has promptly furnished bond, and as a result our ranks are not depleted.

Most of the arrests have been of our members and girl sympathizers for distributing our bulletin, the companies seeming to think that if they could intimidate enough of our members, we might be forced to suspend publication. As a matter of fact the bulletins will be distributed even if we have to mail them. Such a contingency is hardly possible as our members have volunteered by hundreds to distribute copies.

The members of organized labor of Butte are with us. Several of the craft organizations of this city have signified their intention to support us and our demands.

We are demonstrating every day that we are thoroughly and effectively organized. We ask the support of every union man, and a study of these facts must convince you that we are entitled to it.

Our demands are reasonable, as even some of the company officials have admitted. The demands are as follows:

1. The Metal Mine Workers' Union to be recognized by all of the mining companies of the Butte district in its official capacity.

2. The unconditional abolition of the rustling-card system and to reinstate all blacklisted miners.

3. A minimum wage of $6 per day for all men employed underground regardless of the price of copper, as the cost of living demands a higher wage scale for the workingmen. Also surface men to receive an increase in wages in proportion to raise of miners' wages.

4. The mines to be examined at least once each month by a committee half to be selected by this union, and half by the company. The object of this is to avoid, as far as possible, fires and other accidents.

5. That all men starting to work in mines shall be shown exits to other mines so that they may be able to escape in case of fire or other accident.

6. Any member getting seven or fifteen days' layoff, to be given a hearing before a committee, three to be appointed by this union, and an equal number to be selected by the company. If the offense claimed is not proven, the miner or miners shall be immediately put to work and paid in full for all time lost.

7. That all bulkheads must be guarded for the safety of miners by having man-holes built therein.

So much for the most radical side of the strikers.

Other facts that cannot be controverted are that the present labor trobules were directly inaugurated and precipitated by the very worst elements in Butte, and that includes some of the worst in the world. These include

the worst among the I. W. W., lawless Irish and Finn, and all shades of pro-Germans and anti-conscriptionists. Among these again are secreted and hidden from public view the incendiary, the dynamiter, the thug and other criminals who always take advantage of a general disturbance to commit crime and cast reflection on honest or ignorant strikers.

Many honest miners, who recognize the need of a union, tried to wrest control of the movement from the vicious element, but without avail. Hundreds of good miners, rather than become involved in the controversy, the result of which could not be foreseen, left Butte, thus adding further to the strength of the lawless element.

In spite of the "rustling-card" system which the Anaconda company has maintained for several years with the object of getting a life history of every man who applies for work and keeping out of the mines the destructive element, more of that class of men have secured employment than ever before, and while the public seems to have known that the mines were filling up with I. W. W. and enemies of the nation, the company managers appeared to have been in cheerful ignorance of the fact until the climax came, and even then it took them two days to come to a realization of what had been known in every newspaper office for days. Really full realization of the seriousness of the situation did not come to them until about 85% of the 15,000 miners employed in the Butte district had quit work.

Butte, like all forbearing and easy-going American communities and like the American nation, waited and watched developments until the climax of danger had been reached and the harm had been done, and then set about to talk about and plan means for undoing the harm.

Gelasio Caetani

In an article in *the World's Work* for June, Lewis R. Freeman reports an interview with Col. Giuseppe Garibaldi in which the latter tells how he took the Col di Lana. This is of singular interest, not only for its account of an adventurous and dramatic military operation, but also owing to the fact that it introduces one of our well-known and highly esteemed mining engineers, a member of the firm of Burch, Caetani and Hersey, of San Francisco, who, as an Italian citizen, returned to his country and entered its army when it appeared that it was going to war, weeks before the actual declaration. In journeying into the Dolomite Alps Mr. Freeman's attention was drawn to one of the peaks of the range.

"Plainly a peak with a personality," I said to the officer at my side. "What is it called?"

"It's the Col di Lana," was the reply; "the mountain Colonel 'Peppino' Garibaldi took in a first attempt and Gelasio Caetani, the Italio-American minin engineer, afterward blew up and captured completely. It is one of the most important position on our whole front, for whichever side holds it not only effectually blocks the enemy's advance, but has also an invaluable sallyport from which to launch his own. We simply *had* to have it, and it was taken in what was probably the only way humanly possible. It's Colonel Garibaldi's headquarters, by the way, where we put up tonight and tomorrow; perhaps you can get him to tell you the story."

Colonel Garibaldi, telling the story, related how by herculean efforts he got his cannon into the mountains, established them, and had the Col di Lana ranged to an inch. On the appointed day their sudden gust of concentrated fire snuffed out the lives of all the men in the Austrian post before they had time to send word to their reserves of the developing Italian infantry attack. The Italians took the place.

"So far it was so good; but unfortunately taking the summit and holding it were two entirely different matters. We have since ascertained that the fire of 120 guns was concentrated upon a space of 100 by 150 meters which offered the only approach to cover that the barren summit afforded. . . . The enemy counterattacked at night-fall but were able to retake only half the summit."

A line was established between the two contestants from which there seemed little probability that either could drive the other. This was exposed to the fire of the guns of either side and so was comparatively safe from both.

Colonel Garibaldi continues with his story:

"It was, therefore, only natural that, when the Austrians had us held up before a position it was vitally necessary we should have, we should begin to consider the possibility of mining it as the only alternative. The conception of the plan did not necessarily originate in the mind of any one individual, however many have laid claim to it. It was the inevitable thing if we were not going to abandon striving for our objective.

"But while there was nothing new in the idea of the mine itself, in carrying out an engineering operation of such magnitude at so great an altitude and from a position constantly exposed to intense artillery fire there were presented many problems quite without precedent. It was these problems which gave us pause; but finally, despite the prospect of difficulties which we fully realized might at any time become prohibitive, it was decided to make the attempt to blow up that portion of the summit of the Col di Lana still held by the enemy.

Caetani, the Miner

"The choice of the engineer for the work was a singularly fortunate one. Gelasio Caetani—he is a son of the Duke of Sermoneta—had operated as a mining engineer in the American West for a number of years previous to the war, and the practical experience gained in Californi and Alaska was invaluable preparation for the great task now set for him. His ready resource and great personal courage were also incalculable assets. (As an instance of the latter I could tell you how, to permit him to make certain imperative observations, he allowed homself to be lowered over the side of a sheer cliff at a point only partially protected from the enemy's fire).

"Well, the tunnel was started about the middle of January, 1916. Some of my men—Italians who had hurried home to fight for their country when the war started—had had some previous experience with hand and machine drills in the mines of Colorado and British Columbia, but the most of our labor had to gain its experience as the work progressed. Considering this, as well as the difficulty of bringing up material (to say nothing of food and munitions), we made very good progress.

"The worst thing about it all was the fact that it had to be done under the incessant fire of the Austrian

artillery. I provided for the men as best I could by putting them in galleries, where they were at least able to get their rest in comparatively safety. My own headquarters were in a little shed in the lee of a big rock. When the enemy finally found out what we were up to they celebrated their discovery by a steady bombardment which lasted for 14 days without interruption. During a certain 42 hours of that fortnight there was, by actual count, an average of 38 shells a minute exploding on our little position. With all the protection it was possible to provide, the strain became such that I found it advisable to change the battalion holding our portion of the summit every week. Did I have any respite myself? Well, hardly; or, rather, not until I had to.

"During the three months that we drove the tunnel under the summit of the Col di Lana the last few weeks were further enlivened by the knowledge that the Austrians were countermining against us. Once they drove so near that we could feel the jar of their drills, but they exploded their mine just a few meters short of where it would have upset us for good and for all. All the time work went on until, on Apr. 17, the mine was finished, charged, and 'tamped.' That night, while every gun we could bring to bear rained shell upon the Austrian position, it was exploded. A crater 150 ft. in diameter and 60 ft. deep engulfed the ridge the enemy had occupied, and this our waiting Alpini rushed and firmly held. Feeble Austrian counterattacks were easily repulsed, and the Col di Lana was at last completely in Italian hands."

Pollution of Streams

By A. L. H. Street*

Where mining operations are conducted in such manner that the waters of a stream are polluted, and the condition is one of indefinite duration, the right of an owner of downstream property to redress on account of injury to it dates from the commencement of the objectionable conditions and may become "outlawed" by lapse of time, under a view taken by the Virginia Supreme Court of Appeals in the case of Magruder vs. Virginia-Carolina Chemical Co., 91 Southeastern Reporter, 121.

Plaintiffs sued to enjoin defendant from continuing to pollute the waters of a creek above plaintiffs' lands, by permitting the stream to become contaminated by water flowing from defendant's mine and ore-washing plant after becoming impregnated by sulphuric acids and other injurious substances. But the right to relief was denied, because it appeared that the conditions complained against had continued for many years, and that redress was barred by Virginia's five-year statute of limitations.

Steel for Ships

Tremendous resources are being centred on the output of material for ships. The Sparrow's Point plant of the Bethlehem organization is understood to be concentrating on ship steel to the exclusion of much structural goods. Its own shipyard will absorb a great deal of the supplies fabricated, but other yards will probably draw upon the product of the mills, too. Three million tons of shipping, included in the Shipping Board's plan, will require approximately 1,000,000 tons of plates, shapes, etc. In view of the fact that the country's capacity for rolling and fabricating steel is about 35,000,000 tons a year, the Government program would require only five or six weeks for the steel to be produced if all factors were coördinated in the task. The full capacity of the plants naturally could not be completely centered upon it, for the steel trade as a whole would be badly disorganized. But the steel makers, it is known, are speeding up the output of Government ship material and deliveries are looked for as rapidly as the shipbuilders can handle the steel.

Business Conventions Should Continue

Believing that conventions of trade, commercial and professional organizations are even more necessary and advantageous now than in times of peace and that the cancellation of annual meetings because of the war are due to mistaken notions of economy, the Merchants' Association of New York asked President Wilson to discourage the postponement of conventions. The following statement was issued in response by Secretary Tumulty on June 8:

"The President asks me to say that he agrees with you that there is no sufficient reason for foregoing the holding of conventions and general commercial meetings by business interests, so far as he can see."

Aluminum-Iron Alloy

An alloy containing 1-6% Fe and at least 70% Al is superior to aluminum alone, claims its patentee. Other metals, such as Zn, Cu, Ni, Cd, Mg and Mn, may be present, but Si is preferably absent. This alloy has greater density and toughness and increased physical properties in general. It permits the full chilling effect by the mold and die reduction of shrinkage in casting.

The inventor thinks that the use of the alloy in the manufacture of shell fuses and detonators will reduce, by reason of its greater density, the danger of gas leaks causing premature explosions.

The Torsional Strength of Pipe

In the *Journal* of June 2, 1917, there was published a short item showing the torsional strength of wrought pipe, in which two mistakes occurred. The twist was the result of 713,000 in.-lb. torsional stress, instead of 713,000 lb. stress. Again, the caption under the engraving said that the pipe was wrought iron, whereas according to fact it was wrought steel—"National" pipe, manufactured by the National Tube Co., of Pittsburgh, Penn. These corrections are due the company that manufactures this product.

Nickel-Copper Steel

Experiments made by Prof. George A. Guess, of Toronto University, showed that a limited percentage of copper in steel is not objectionable. In fact, a small amount is beneficial for some purposes and is capable of advantageously replacing a proportion of the nickel in nickel steel up to at least one-third of the combined quantity of nickel and copper.

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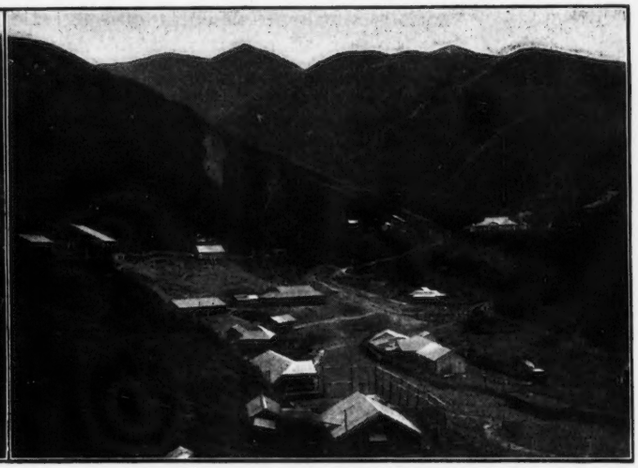
Bawdwin Mine in Upper Burma

OLD NORTH VALLEY VILLAGE, BAWDWIN

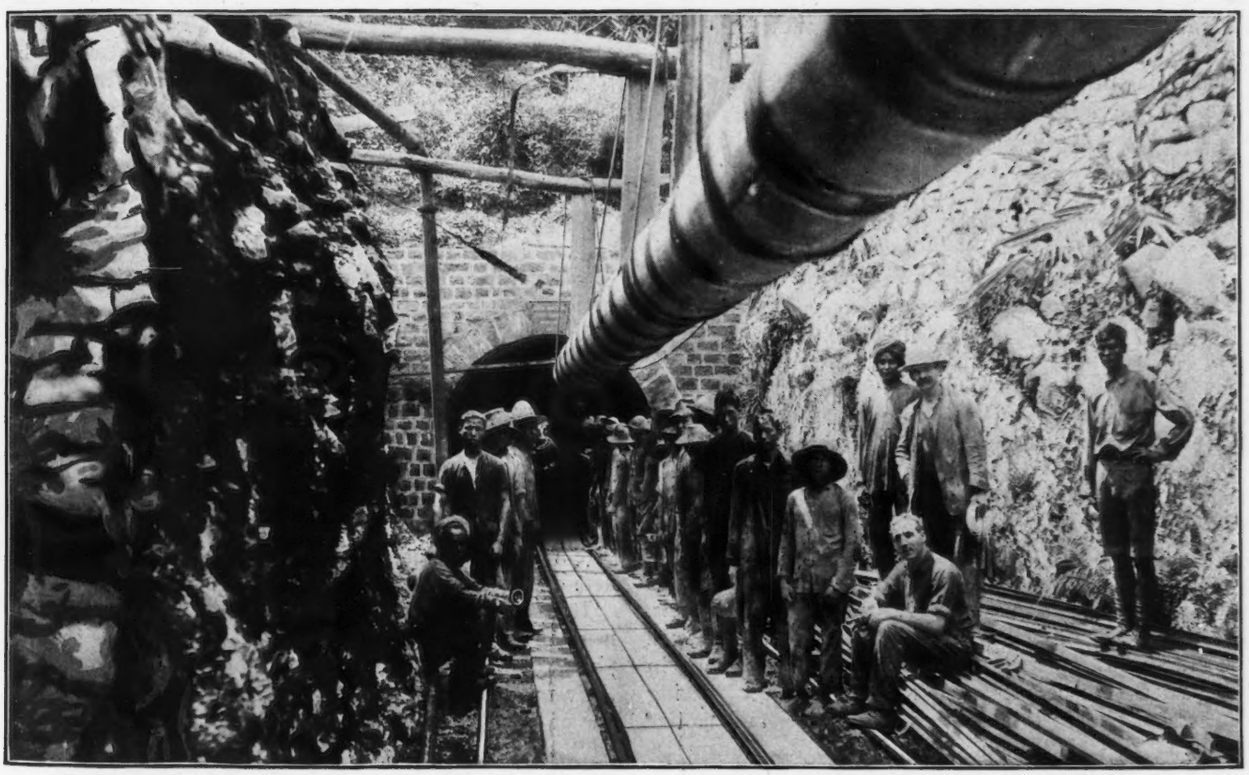


PRESENT-DAY GENERAL VIEW AT BAWDWIN

GROUND SLUICING THE GRAVELS OF THE NAM MA FOR OLD CHINESE SLAGS.

The Chinese operated the Bawdwin mine for silver and lead several centuries ago. The old slags left by the Chinese formed the basis, until recently, of the lead-smelting operations of the Burma Corporation; this company's subsidiary, the Burma Mines, Ltd., is now preparing to treat the complex silver-lead-zinc ores that the Chinese were unable to handle profitably. Modern metallurgy has converted the complex ore deposit into one of the world's richest silver-lead-zinc mines.

THE LORING VERTICAL SHAFT ON THE BURMAN OREBODY



TIGER TUNNEL—OUTLET FOR THE GREAT LEAD-SILVER-ZINC OREBODY OF THE BAWDWIN MINE

Since this photograph was taken, the Tiger tunnel has made connection with the Chinaman orebody, having "holed through" to the internal shaft on Sept. 22, 1916. The total length of the Tiger tunnel is 7250 ft. It opens the mine about 750 ft. below the outcrop which is at an elevation of about 3500 ft.

Events and Economics of the War

Recent news from the various theaters of war is lacking in interest. On the western front the condition is described as jockeying for position. A deadlock prevails on the Italian lines. The Allies' situation in Greece seems improved and the increase of unrest in Austria, while Russian disorder lessens, which is another hopeful sign.

An effectual curb for the submarine is still being sought.

A modified embargo of exports, especially of those for neutrals, is about to be declared in this country, and food prices are expected to fall in consequence.

Congress is still debating the subject of food control into which the question of nation-wide prohibition has been injected.

A large aërial fleet seems assured, and likewise greater efficiency in building ships now that the quarrel between Denman and Goethals is apparently settled.

Howard Elliott on Car Shortage

Car shortage is a misnomer, though not where the shipper is concerned, because he is not getting all the cars he needs. But it is a misnomer in that failure to supply cars is due not so much to the nonexistence of enough cars as to the fact that the railroad system is overtaxed as a whole because of lack of terminals, sidings and of modern appliances on some of the railroads, and lack of modern appliances by shippers and receivers of freight in some places, so that the maximum use of each car is not obtained.

These facilities have not been added to as they should have been in the last five or ten years. On May 1 there was a so-called shortage of 150,000 cars. In round numbers there are 2,500,000 cars in the United States. If, by a little better loading and unloading by the shipper, a little better movement by the railroad, and a little more alert work by every man in the railroads, from the president down to the water boy, each car was used a little better, it would not take very long to get that 150,000 cars out of the 2,500,000 cars. It is about ¾ of 1%.

The roads, in spite of their difficulties, have done a good deal in the last 18 months to add to their cars and engines. But in spite of this, the Railroads War Board feels, that if the war goes on as we fear it will, the total amount of transportation that can be manufactured when men are called to the colors or sent to France, or have to go into other forms of work, will not be sufficient.

I am afraid there will be a continued shortage of transportation. In that event it is going to be necessary to use such transportation as there is for the essential things. The public should willingly give up the nonessentials. We are suggesting that there be some changes made in the passenger schedules, not with the idea of saving money, but simply to save man power, fuel and motive power, all of which should be applied to the transportation of necessities.

This matter is so important that Congress has taken it up and there has been introduced, at the instance of members of that body, a bill which will empower some agency of the Government, under the direction of the President, to say to what commodities the railroads must give preference.

It is essential to the welfare of the people that some such measure be enacted. We have courageously started out to do these things, and yet, in doing them we have of necessity run counter to some Federal and state laws. Sooner or later we will have to stop unless, as a war measure, the Federal power says, "You must do this," without being subjected to countless damage suits.

Railroads Want Federal Control

It is the belief of the railroad executives, says a booklet entitled "The Railroad Situation," issued by the Guarantee Trust Co., that if they can be relieved of the conflicting, wasteful and inefficient regulation of 48 states and the Federal body, and if this regulation can be unified under one head, with regional subdivisions, a great part of their present difficulty will be removed. Upon this platform the railroads have taken their stand and ask for public coöperation, not in their own interest, but in the public interest, because the business of this country can prosper only as it is adequately served by efficient transportation.

Railroad economy and efficiency, under most exacting and embarrassing conditions, have accomplished such surprising results that still greater advancement might be expected under the encouragement of fair and reasonable regulation. Constructive suggestions which may be offered to relieve the railroad situation immediately may be briefly summed up as follows:

First—Increased rates.

Second—Federal regulation of rates and security issues.

Third—A larger Interstate Commerce Commission with regional and functional divisions.

Fourth—Coöperation on the part of legislative, regulating and shipping interests to protect railroad credit and to further railroad expansion.

Fifth—Coöperation of investors to protect and maintain railroad credit.

Sixth—Recognition of our national unity of interest in a fundamental economic problem.

These are all obviously possible, and if provided would give a great impetus not only to the railroads but to business generally.

It is this intimate connection between the railroad business and other forms of business which must be emphasized. The attitude of the American people toward their railroads as a whole for the last 10 years has been one of detached criticism and punitive legislation. They have treated the railroad interests as though they were something apart, from which the last possible ounce of service at the lowest possible cost might properly be wrung. Their eyes have been focused solely upon their

immediate selfish interest. This policy could have but one effect, which is now glaringly apparent.

It is conservatively estimated that more than $1,000,000,000 a year in new money must be put into the transportation system of the country in order to meet its pressing needs. This money must be raised through the sale of new securities. In order to be assured a market under the severe competition now existing for investment funds the earning power and stability of railroad investments must be firmly established.

The solution to the problem is offered in the continuation of private ownership and operation properly regulated and protected. It may be confidently expected that the American people, with their long record of constructive achievement, will deal with the subject as decisively and constructively as they have with economic questions of similar magnitude in the past.

Freight charges on railroads in the United States are the lowest in the world, as is also their capitalization per mile. The wages paid their employees are the highest, while their operating efficiency is greatest. Yet this great transportation system embracing over 250,000 miles of road and representing a property value of over $17,000,000,000 was permitted to earn a return of less than 6% last year on the value of its property and equipment used by the public. In a year of unprecedented activity and unparalleled general prosperity such a meager return to our railroads shows most convincingly the need for relief.

Food Conservation

Herbert C. Hoover on June 17 outlined his plans for enlisting the nation's housewives as actual members of the food administration and appealed to them to join him in the fight for conservation measures and the elimination of waste. The women will be enrolled during a period of registration from July 1 to July 15 through the Council of National Defense and the State Defense Councils.

Instructions for food conservation and the elimination of waste will be sent by Mr. Hoover to every woman enrolled. The six cardinal principles of the instructions will urge these policies of conservation in the households of the United States:

At least one wheatless day a week, substituting corn bread or other cereals.

Less meat in the daily menus, smaller portions and no waste.

No butter for cooking, less butter for the table, less lard, bacon and other pork products; all this to conserve the fats needed in war time.

Increased use of fish and vegetables to cover the deficiencies in food supply.

Purchase of locally grown products to cut down the burdens on transportation.

The spreading of "gospel of the clean plate" and the elimination of all food waste.

"As requested by the President," said Mr. Hoover, "we ask every woman in the United States engaged in the personal control of food to register for actual membership in the food administration, thus entering directly into the national service. We shall later on ask various classes of men likewise engaged in food preparation and distribution to also volunteer to the national service in their various branches."

Mr. Hoover estimates the annual waste of food in this country at $1,000,000,000. He urges a larger use of corn and corn bread in the family ration.

"The women of America," he says, "have never failed to answer such a call as comes to them now. The saving of food is within their sphere and without food conservation we cannot hope to win the war."

To Build an Aerial Fleet

A new American airplane engine, developed from the most efficient air fighting engines in use by the Allies, will be the basis of the mammoth aërial fleet which the Government will construct as rapidly as machines can be turned out and pilots trained to operate them. The new engine has been designed in large part by Howard Coffin, of the advisory commission of the Council of National Defense, and automobile engineers working under his direction. It is designed for great speed and rapid climbing and maneuvering.

Plans for the expenditure of $600,000,000 for the construction of tremendous aërial fleets in this country have been in the making for months. They were not formally put up for the approval of the War Department until the engineers felt confident that they could present to the country an airplane engine capable of coping with the highest development of that art abroad. The coöperation of foreign war offices was obtained and plans and designs of French, British and Italian fighting airplane engines were furnished Mr. Coffin, himself one of the leading automobile engineers of the country.

The Bureau of Standards is now engaged in standardizing the machinery and patterns that will be used in turning the engines out in tremendous quantities. The bigggest automobile factories in the country probably will be used so largely that, according to one authority, the output of pleasure cars may be materially curtailed.

Red Cross Dividends

In last week's issue was recorded the announcement of dividends for the benefit of the Red Cross by a number of mining and metallurgical companies, which amounted to $8,828,506. Since then the following have announced similar payments:

Company:	Per Share	Total
Mohawk	$0.50	$50,000
Wolverine	.50	30,000
Kerr Lake	.15	45,000
Miami	.25	93,389
Inspiration	.25	30,000
Anaconda	.50	1,165,625
National Lead	1.00	206,554
Arizona Commercial	.10	26,500
Bethlehem Steel, "A" and "B"	1.00	600,000
St. Mary's Mineral Land	.05	8,000
United Verde Extension	.10	105,000

These dividends, amounting to $2,306,068 bring the total to date to $11,188,574. The Miami and Kerr Lake companies suggested that one-half of their dividends be donated to the Red Cross fund and one-half to the Army and Navy Branch of the Y. M. C. A. Only the Red Cross portion is included in the tabulation and total.

A conference of American physicists with the French scientific mission has just been held in Washington under the auspices of the National Research Council. This is a result of an urgent request made by the members of the mission for a comprehensive attack upon the scientific side of the problem of submarine detection.

Editorials

The Matter of Prices

Recent statements and actions by Secretary Daniels caused alarm in the mineral and metal industries, which had already been seriously disturbed by the dilatoriness and uncertainty in his quarter. Finally he thought apparently to cut the Gordian knot by ordering the coal producers to furnish the coal needed by the navy at $2.33 per ton, pending determination by the Federal Trade Commission of what it considers a reasonable price. Similarly, the oil producers were simply ordered to furnish oil, price to be left to the F. T. C., the Navy Department in the meanwhile advancing 89c. per bbl. The steel producers were told that the price for their product would be 2.9c. per lb. The Advisory Commission for National Defense had previously advised Mr. Daniels that $2.95 for coal was a fair price, and the American Iron and Steel Institute had said that the steel producers should get 3.5c. per lb. for steel in order to obtain a fair profit, but for expert advice, even when disinterested, Mr. Daniels manifestly cares little, and he pronounced the dictum that to give anything over 3c. per lb. for steel would be "going too deep into the nation's pocket."

On June 20 he announced that he had called the Federal Trade Commission into conference, and requested it to ascertain without delay the cost of production of all basic raw materials entering into the manufacture of munitions or power for the navy. Copper, steel, coal, iron and fuel oil are included, and Mr. Daniels said that when the production cost for such articles is established, the price to be paid by the navy will be fixed, allowing for a fair, even liberal, profit, to the producers. "Beyond that," the Secretary added, "I am not going to pay."

Unfortunately, nobody that we know of, except Mr. Daniels, has much confidence in the intelligence of the Federal Trade Commission. The ideas of that strange body are illustrated in a report on the coal situation that it issued on June 20, in which in recommending a remedy is said:

> If the producer at each mine were paid his full cost of production, with allowances for depletion, maintenance, upkeep, and all the usual items, and to this were added a fixed and uniform net profit per ton, with due regard to quality, the coal thus produced, at widely varying costs, if pooled, could be sold through the Government at an average and uniform price, quality considered, which would be entirely tolerable to the consuming public, and a price much lower than could be fixed if an effort were made to fix a uniform price to the producer. It would seem that steady employment, fair compensation to labor and capital, equitable distribution and stable prices could be secured.

The application of this preposterous project is staggering to the imagination. Even more so is Mr. Daniels' idea that the F. T. C. can determine the cost of production of a long list of commodities within any time that will correspond with the duration of the war, using even the most pessimistic estimates. Why, take the case of copper alone: The experts have been trying for years and years to determine average costs in that most highly organized and most statisticated of all industries without being able to come to any conclusion. Nor is any definite conclusion possible except that which is deduced from the market price, which says in substance that it is what it costs to produce the last pound of copper needed at any given time, plus the profit, that makes it worth while to produce it.

Are we now, following the theories of Mr. Daniels and the F. T. C., going to see it pronounced that some percentage on cost of production is a fair profit—say 20%—and have the copper requisitioned on that basis? Supposing the cost to the Kennecott company is 5c. per lb. and to the Franklin, 20c. per lb., is the former to be paid 6c. and the latter 24c.?

Most of the copper companies talk about a certain figure as being their cost of production. This is a convenience, especially for comparisons. The figures do not really have much more than comparative value. We venture to say that there is not one copper producer out of ten who knows what is his real cost of production. Two of the largest producers—Anaconda and P. D. & Co.—never give any figures of this kind, for they cannot. Is the F. T. C. going to do what the expert engineers and auditors of those companies cannot do?

But there are more serious aspects of the policy indicated by these perverted ideas, which emanate from ignorance. If Mr. Daniels so trims the profits of the producers, what becomes of the plan to draw great taxes from their excess profits? We should like to know what Mr. McAdoo thinks of that phase of the matter. But the most serious thing is the mischief that is played by interfering with the great natural law of supply and demand, just as if grit were carelessly thrown into a delicate system of gears, and with this is associated the misguided thoughts of Congress in its efforts to frame a workable system of taxation of excess profits. Let us give an illustration:

Two years ago the price for zinc rose to fantastic figures owing to there being insufficient smelting capacity to supply the demand. The possibility of great profits induced venturesome capitalists to spend millions in providing new capacity. Everybody knew that the time of phenomenal profits would be but ephemeral. The adventurers reckoned that they would probably have to get their money back in a year or less in order to realize any real profit. Even so, many of us thought they were reckless. Now the very thing they did produced the anticipated result, as it had to, for was it not the true operation of the law? As soon as sufficient smelting capacity was provided, the price of zinc declined, and at present it hovers around a figure which is high in comparison with that of three years ago, but is nevertheless a price of narrow margin to many producers in view of present costs for labor, material, etc. Is any Federal Trade Commission going to make a prettier determination than this?

At the present time the United States is in urgent need of certain things whereof the domestic supply is insufficient. The country possesses certain deposits of them that heretofore it has not been profitable to exploit.

Some of the enlightened bureaus of the Government, doing their duty, have urged that attention be directed to the more promising of these, but the bureaus have no funds wherewith to develop them. Therefore there must be an attempt to interest private capital. But how is private capital to be interested if Mr. Daniels has his way and tells it that it may have only cost of production, plus what he or some clerks of the F. T. C. deem to be a reasonable profit, with the prospect staring it in the face of having to close down and sacrifice the principal invested when the war is over? And how is capital to be interested if Congress tells it that all the profit is excess profit, a large part of which must be yielded to the tax-gatherer?

Great Britain went through just these things in the early days, practicing the same unintelligent policy, though perhaps in a less crude, less rasping way, and saw languish the production of those things that she needed badly. In the end she had to *subsidize* industries, herself furnish them with capital, in order to get the production that she needed. Are Mr. Daniels and Congress prepared to think of that? Will they not please consider what harm they are threatening the nation by the cheeseparing policy, by the idea of conducting a cheap war?

We of the mining and metallurgical industry resent the implications that we are trying to extort from Mr. Daniels great profits, when we know that what we are asking is only for such terms as will permit our several industries to be most efficient and produce freely the great supplies that are needed. We resent such nonsensical statements as that "the Almighty put these things in the ground and the only additional cost over normal times is getting them out." We resent being singled out of the great list of producers to be the victims of arbitrary dealings, and stupid allegations. Why should the copper producer be charged with designs for "profiteering" any more than the cotton producer? Why is 25c. copper a thing of foul odor to Mr. Daniels, while 25c. cotton is a blessing to the people?

There would be more alarm in business over the foolish and dangerous ideas that prevail in the great purchasing departments of the Government were it not for the belief that the controversy between the Cabinet Ministers and the members of the Advisory Council who see the error of their ways is close to the stage where there must be an appeal to Caesar; and there is a confidence that the President, who is broad-minded and appreciates the sincerity of the business men, will decree a policy that will oil rather than impede the wheels of production. For it is evident to every one of clarity of vision that what is mostly needed in this country, not only for ourselves but also for our allies, is *production,* and then more production. And we must have the conditions that will give it to us, just as we did in zinc, even if the price be temporarily extravagant, for it is just that which induces the production that is needed.

The Proposed Taxation

It is proposed in Congress to tax the excess profits of corporations, using as a basis the profits obtained during the three years, 1911, 1912 and 1913. It is intimated that profits above that amount may be taxed up to 75%. While we do not suppose it likely that Congress will put through a measure as crude and bald as this, the very idea that such a thing is seriously proposed is enough to give one the blues unless he is sure that certain modifications will be introduced to insure fairness. As applied to the mining business especially, it can easily be shown how such a proposition might be outrageously unfair.

First: The standard to be taken is approximately one of five years ago. Everyone acquainted with mining knows that great changes might take place in that length of time, either in the way of favorable or unfavorable developments, or in changes of management, both of which would in an enormous number of cases work tremendous changes in the position of a mining corporation, war or no war. For instance, we may cite the case of a company in which during the last five years changes have been effected in the way of completion of plants, improvements in methods and in management, that entitle this concern to three or four times the profit it was making in the period adopted as a standard, without any aid whatever from the actual war conditions. If this concern should pay taxes of 75% of its earnings as increased since 1912, it would be nothing short of confiscation of capital.

Similarly, take the case of a concern like the United Verde Extension, which was not in existence in 1912. Is it to pay 75% of all its earnings? As a matter of fact it is a mine capable of producing copper very cheaply; and under a normal scheme of things, without any war, it should make somewhere around half the money it is now making.

Take, on the contrary, a case in which a mine has gone downhill so far as its physical resources are concerned. Its profits today may not be any greater than they were in 1912, therefore it may escape excess taxation altogether. Nevertheless, a property of this kind may have so deteriorated that without the stimulus of war prices it would not be running today at all, and its profits reasonably analyzed might prove to be all due to the war, whereas other concerns more valuable and prosperous would owe their profits only partly to the war. And yet our decadent mine might escape taxation altogether.

Second: We have always supposed that the Constitution of the United States provides against class legislation. Now it might appear that corporations are being picked out for excess profits on the supposition that they may be treated as individuals who are obtaining an undue share of the advantages of the present situation. This is not true. The Anaconda Copper Mining Co., for example, is not an individual, but is a group of twenty thousand people. Its profits in 1916 were some fifty million dollars. At the same time we estimated that under normal conditions with its business conducted as at present, its profits would be some twenty-three million dollars. The difference, twenty-seven million dollars, might be credited to excess profits. Even that is a point which is open to question for this reason: When we figure on normal prices for a commodity, we have to take in both periods of high prices and periods of low prices, and at least a portion of the present high price of copper would be reached at any period when this country enjoys a business boom, war or no war.

But suppose we admit that the Anaconda Copper Mining Co. earned twenty-seven million dollars excess profits in 1916; what of it? Divided among its twenty thousand stockholders the twenty-seven million dollars is no very great thing for each, and the mere fact that these twenty thousand people are handling their business cooperatively and that they are dealing with a metal instead of some other commodity should not expose them to taxation any more than individuals of any other class. How

is Congress to know for instance, that twenty thousand cotton planters have not obtained twenty-seven million dollars excess profits also? The fact that it would be difficult to look into the accounts of twenty thousand individuals, while it is very easy to find out the record of a corporation owned by twenty thousand stockholders is not a good argument for allowing the twenty thousand on one hand to escape taxation and the twenty thousand on the other side to have it in an exaggerated form.

Third: This proposal may also be attacked on the ground of public policy. The owners of corporations that are to be taxed in this manner are sure to feel that they are bearing more than their share of the burden of the war. Everybody knows that the war cannot be financed by direct taxation, but the major part of it must come from the sale of bonds. People who feel that they are paying five or ten times their share of taxes in proportion to the value of their capital are not likely to buy bonds.

We have cited these three reasons operating against this proposal, not so much to antagonize the whole idea of excess profit tax as to indicate how it may be grotesquely unfair unless it is imposed with a just consideration of all the circumstances and with broad provisions to prevent injustice. In other words, such a proposal does not seem to be a simple thing by any means, but one to which Congress should give the most serious attention before rushing it through, for it should be plain to every thinking man that the resentment caused by unfair taxation may defeat the very cause that it is intended to promote.

Rumblings in Arizona

Rumblings in the Clifton-Morenci-Metcalf district indicate the approach of more labor trouble. Agitators have been busy in the camps for the last 20 or 30 days, and a walkout was scheduled for last week. The union made some demands on the companies June 18, but, what was a surprise to all, it gave the managers 10 days to think them over. This inclination to encourage meditation, however, is considered favorable to the continuity of copper production. As yet no statement of the demands has been given out, but it is generally thought that, in a somewhat lengthy list of inconsequential indictments, a hesitant longing for the Miami scale of wages will be found. But it seems somebody has tipped off the men that the accounting departments grind out a figure known as "tons per man" and that that figure is much smaller in Morenci than in Miami; and also, but not least, the managers would not be so reluctant to pay the Miami scale if it were followed by the Miami man-production. This gives Juan food for thought while he waits for the clock to indicate the time he must begin filling the next car. Of course the bookkeepers have no business doing such a thing, but as it is a fact, it must be considered.

Suppose the managers were to take a step so rashly at variance with the aims of organized labor. The questions arise whether the companies would get somebody else to put all that ore in the chutes for Juan or whether he himself would be required to fill up 10 cars a day or get out. *Quien sabe?* The subject will bear thought. Also the operators already have evinced a presumptuous disposition to run their mines to suit themselves. This not only reflects discredit on the union régime since the close of the strike in January, 1916, but also it is not in accordance with the principles of unionism as commonly preached. However, after all, there are not many cars in the Morenci mines and one can live on $4 a day, therefore *manana* would be a good time to talk it over.

The Labor Trouble at Butte

The labor trouble at Butte has attained unexpectedly serious proportions. While this was, without any doubt, stirred up by pro-German interests, seeking deliberately to make trouble, it is clear now that there was an underlying dissatisfacton among the miners. The North Butte disaster afforded the psychologic time for the pro-German agitators, self-seeking labor leaders and others to crystallize this, and they took prompt advantage of it.

The dissatisfaction may be said to focus on working and living conditions in Butte. With respect to most of the grievances, the companies are not responsible, and the complaints of the men should really be directed to other quarters. Thus, in the matter of safety in the mines, the Anaconda company has been among the leaders of the mining companies of the country in promoting safety measures. Such a company does not want to have accidents any more than the men do. Indeed, the company is notoriously more careful than its men. The recent accident in the North Butte—which is not an Anaconda mine—was distinctly due to the carelessness of one of its employees, was due to gross stupidity and was entirely beyond the control of the management; yet the North Butte company is obliged to pay—and properly to pay—a large sum of money under the Workmen's Compensation Law to provide for the families of those men who innocently lost their lives.

When the striking miners of Butte demand the dismissal of the state mine inspector and demand a rigid enforcement of the state mining law, they should direct their attention not to the companies, but to the governor and the state legislature. The United States Bureau of Mines in Bulletin 75 has drafted a model for state legislation for safety in mining, which has been adopted with satisfactory results by several of the states. Let the miners of Montana demand the enactment of that law, with the minor modifications necessary to adapt it to the peculiar conditions of their mines, and they will have a solid basis on which to act. We feel sure that the companies would not oppose such a movement.

Furthermore, let the labor leaders and their unions preach among themselves that any man who disobeys the law of the state is a man who should be punished more or less severely according to the heinousness of his offense and the provisions of the state law; let them agree that the companies shall have a free hand in dismissing such men, who endanger the lives of others (just as did the guilty man in the North Butte accident); let the labor leaders agree to such a policy as this, and the matter of safety in the mines in which they earn their living would be improved in a more effective way than they have talked about or thought about. In order to obtain such a betterment of conditions, it is not necessary for them to strike or to complain against the companies. Their real complaint should be against their representatives in the legislature. If their representatives do not properly represent them, let them at the next election put in men who will.

Nor have the Butte miners any just complaint against the companies on the subject of living conditions in general. Butte is not a district of company stores, company boarding houses, etc. The men who work in the mines live in the city and its outskirts, the mines being close by, in such ways as they want to. The companies have exhibited no spirit of paternalism. Perhaps it has been regarded that such a spirit was not desirable. The miners of the Calumet & Hecla showed scant appreciation of it when they struck a few years ago. There is, however, one thing that the Butte companies have earnestly striven to do, and that is to eradicate the influence of the rum saloons. Nobody appreciates better than the managers the disastrous results of alcohol when imbibed by workmen. It is rather humorous that the strikers should now be finding fault with the companies for not having exterminated the saloons.

The crux of the matter between the companies and the miners is the demand of the latter for increased wages. The miners are already getting the highest wages ever known in Montana. The companies have in a way made them partners in the business, giving them wages that increase on a sliding scale, according to the price for copper, so that when the companies make more money the men earn more. This is eminently fair, and heretofore it has been supposed to be quite satisfactory. But the men now say that they are not getting enough. They say that when their wages advance, the landlords and tradesmen of Butte advance their charges. The landlords and tradesmen say that they have to advance them owing to the increasing demands of the mechanics—the plumbers, the carpenters, brick masons, etc.—who work for them. Here we have an exhibition of the same old vicious circle, the working of which is at last being recognized by the highest among the labor leaders. It will do the miners of Butte no good to squeeze more money out of the companies. This real solution of their troubles is economy, and in getting it they ought to make the beginning by fixing things with the unions in other trades. Unless they do, the vicious circles will rise and rise higher, until some day they will break with general disaster.

Subscriptions to Belgian Kiddies, Ltd., up to date amount to $97,705.67.

BY THE WAY

To other gems of brevity should be added the opinion of an engineer on the merits of consolidating some properties: "The consolidation is based on the assumption that putting four dead cats together will make one live one. This is an error."

We note with regret that the *Excavating Engineer* has temporarily suspended publication. While it was a "house organ," it was one of the best of its kind, and gave from time to time refreshing information upon the subject of earth moving that was especially valuable because it emanated for the most part directly from the operators of steam shovels, dredges and other earth-moving machinery. The regret felt over the suspension of this publication is tempered by its cause—both the editor and his assistant have joined the colors. Bradlee Van Brunt, the editor, closes his announcement of suspension of publication with the following words: "When our armies return victorious we will again be on the job. When such a time arrives it is our confident hope that those who have been with us in the past will not have forgotten the 'Excavating Engineer,'" We feel sure that former readers of Mr. Van Brunt publication will look forward with pleasant anticipation to its resumption and expect to find some interesting pointers on rapid dirt moving as practiced "somewhere in France."

Edward Eyre Hunt in an article in the *World's Work*, for June, on "Hoover of the C. R. B., says the following about mining engineers, under the sub-head "The Glory of the Mining Engineers:" "There must be something about the mining engineering profession which encourages these traits. I confess I do not know how to define it, but there seems to be an unusual esprit de corps and a high level of professional honor and sensibility which marks mining engineers out from the mass of men. It cannot be an accident that Herbert Hoover and practically all of his more important assistants in Belgian relief work have come from this group. It can hardly be an accident, either, that the Rocky Mountain Club, a club of New York mining engineers, gave up $500,000—all that they had been saving for a new club house—and handed it over post-haste to Hoover to be spent for Belgium; or that still another group of mining engineers have formed a corporation called "Belgian Kiddies, Ltd." for the purpose of aiding the children of Belgium. For these men seem to be creating among themselves a new type of citizen. There are few dictators in their ranks. They seem to like coöperation."

"Going out to lunch used to be a religious rite; friends of mine always went out to lunch with a loud noise; but this is all changed," says a New York correspondent, "since Food Director Herb Hoover, over in Washington, set about to 'make economy fashionable.' This has proved an expensive slogan for me, as was demonstrated today. I came downtown about the witching hour of 12 and immediately called up several of my friends. I was unable to connect with any of them, and their stenographers said nothing whatsoever about lunch. When I called up a friend in the good old days he said one of three things: 'Come down and take lunch with me,' 'Can't we talk it over at lunch?' or 'I will meet you at the Gigantic at lunchtime.' Lunch was the one event of the day in every business man's life. Today you don't hear any more about lunch than you hear about the peace propaganda. The professional lunchers are apparently as retired as the foreign secret agents. Lunching ensemble has gone out of style. They go to lunch just the same, but they don't advertise the fact. They are more modest about it. They do not sound the tocsin to summon the hungry. They simply sneak out of the back door and go to lunch. Nowadays when you get a man on the 'phone he says: 'Come down AFTER lunch.' The word 'after' sticks up as prominently as a rum blossom on a temperance lecturer's nose. Again we must note in our faithful diary that General Sherman was eminently right. It is even worse than he claims it to be."

Personals

Sydney H. Ball will shortly go to Russia on professional business.

J. Parke Channing has returned from a prolonged trip through the West.

J. R. Finlay has returned from an extended trip through the West and in Missouri.

C. M. Weld, of New York, was in Tennessee this week. Mrs. Weld accompanied her husband.

Allen H. Rogers is in California and expects to be there for several months, engaged in professional work.

J. S. Coupal has gone to Arizona to make examinations for interests represented by Kirby Thomas of New York.

Charles Mentzel has returned to New York after having been engaged for two months on examinations in New Mexico.

Herbert C. Hoover is now "Doctor Hoover," the degre of LL.D. having been conferred on him by Princeton University.

W. H. Wright, of the Malon-Wolf Co., of Denver, recently examined mining property in Ross Basin in San Juan County, Colorado.

O. H. Wharton, formerly general sales director of the Crucible Steel Co. of America, will become president of that company on July 1.

Robert C. Stichi, will address the San Francisco Section of the American Institute of Mining Engineers on July 10 on "Pyritic Smelting."

W. H. Rodgers and J. F. McBride have been ordered to Butte to assist in adjusting labor troubles, in their capacity as Government mediators.

Edwin R. Eaton has resigned as manager of the Manganese Products Co., operating in Rye Valley, Virginia, and will take up other work in the South.

Major Arthur S. Dwight has resigned from the Council of the Mining and Metallurgical Society of America, as he expects to leave the United States very soon.

R. H. Stewart, formerly manager of the Consolidated Mining and Smelting Co., at Trail, B. C., has established an office at Vancouver, B. C., as consulting engineer.

F. F. Sharpless has been elected a member of the Council of the Mining and Metallurgical Society of America, to succeed Major Arthur S. Dwight resigned.

Edward P. McCarty, formerly professor of mining in the University of Minnesota, has established a general practice in mining engineering, with offices at 3615 Lyndale Avenue South, Minneapolis, Minn.

Francisco Massillon, formerly in charge of iron operations in Mexico, is now at Barcelona, Spain, engaged in general engineering practice. His address is Calle Diputacion 349.

John G. Worth has received a commission as Captain Quartermaster, Quartermasters Reserve Corps, U. S. A., and has been assigned to the Remount Depot at Front Royal, Va.

Fayette A. Jones has resigned from the presidency of the New Mexico School of Mines and has left for Alaska where he will spend the rest of the summer inspecting mining property.

Richard Rous Mabson, author of the well-known work, "Mines of Africa," has retired, at the age of 70, from his 37 years' joint editorship of the "Statist," the London financial paper.

Morril B. Spaulding has accepted an engagement with the Emergency Fleet Corporation in a consulting capacity for special work and has gone to Washington for that purpose.

Dr. Henry M. Howe has been elected a member of the National Academy of Sciences, a distinction, as new members are chosen from the distinguished men of science of the United States, the Academy being comparable to the Royal Society of London.

Montrose L. Lee, who has been in Hayti for several months, has returned to New York. He expects to go to London soon where he will be attached to the foreign department of S. Pearson & Son, Ltd., at 47 Parliament St., Westminster.

Frank H. Crockard, recently vice president of the Tennessee Coal, Iron and R.R. Co., has been elected president of the Nova Scotia Steel and Coal Co., Ltd. He succeeds Col. Thomas Cantley, who becomes chairman of the board of directors. Mr. Crockard will have charge of plans for a considerable extension of the company's operations.

Alfred H. Brooks, formerly in charge of the Division of Alaskan Mineral Resources of the United States Geological Survey, has been appointed a captain in the Engineer Officers Reserve Corps and ordered to report for training. During his absence George C. Martin will be geologist, acting in charge of Alaskan work.

Obituary

M. K. Rodgers, mining engineer, formerly operating in Calaveras County, Calif., died at Pittsburgh, Penn., in June, 1917. Rodgers was discoverer of the Nickel Plate mine in British Columbia and was chief engineer of the survey of the Northern Pacific R.R. in Montana.

Cyrus R. Hall, widely known mine operator of Colorado, was buried recently in Monrovia, Calif., where he had been living for the last five years. He came to Colorado from West Virginia in 1860 and became one of the builders of the mining industry of Park County and Leadville, later going to the Cripple Creek fields when the gold boom was on. He was born in 1841.

Eugene H. T. Chen, mining engineer and graduate of the University of California, died in Yunnan province, China, in May, 1917, as result of forest fires believed to have been set by Chinese brigands. Word of his death was received on June 7. On leaving Berkeley, Chen went to Yunnan, the farthest inland of the southern provinces and was the first mining engineer to undertake mining and prospecting there.

Dr. Robert Bell, the noted Canadian geologist, formerly director of the Canadian Geological Survey, died on June 18 at his home near Portage la Prairie, Manitoba, aged 76 years. He was born in Toronto and at 16 entered the service of the Geological Survey. In 1867 he was appointed professor of science in Queen's University, but did not retain the position long, preferring to devote himself to geological field work. His special contribution to science was the mapping of large portions of the territory between Labrador and the Rocky Mountains. He surveyed the great rivers of western Canada and made track surveys of many of its lakes, and acted as geologist and naturalist with expeditions to Hudson Bay. In 1877 he was appointed an assistant director of the Geological Survey, and, on the death of Dr. Dawson in 1901, became director, retaining the position until 1906. Dr. Bell was superannuated in 1908. He contributed much to scientific journals, but his most valuable publications were his annual reports of field work. He was a delegate from Canada to the International Geological Congress at Vienna in 1903, a Fellow of the Royal Society, and an LL.D. of Cambridge University. In 1906, he received the King's Gold Medal of the Royal Geological Society and the Cullum Gold Medal of the American Geographical Society.

Frank M. Murphy died at Prescott, Ariz., on June 23, at the age of 62, after a short illness. He was a native of Maine, and is survived by a wife. Murphy came to Prescott in 1877, and served as clerk in several of the pioneer stores. He entered politics and in 1883 was a commissioner to the Denver mining exposition and went to New Orleans the following year in the same capacity. In 1887 he interested "Diamond Jo" Reynolds in the Congress mine, in Yavapai County. The need of transportation to this mine caused the building of the Santa Fe, Prescott & Phœnix R.R., financed by Reynolds and capitalists associated with the Santa Fe system, who placed Murphy in charge. In 1893, Murphy organized the Prescott National Bank, of which he was president till 1910. He secured extensions of the Ash Fork-Phœnix line, on a route that was intended to give the Santa Fe system a new outlet eastward, by way of El Paso, though in this last effort he failed. He planned, also, a rail connection with the Gulf of California from his Red Rock-Silver Bell mining road, which never got beyond location surveys. About 15 years ago, Murphy organized the Development Company of America, which took over control of the Congress mine, the Poland mines in the Bradshaw mountains, the Imperial mines, smelter and railroad, west of Tucson, and the famous bonanza mines at Tombstone. A deep shaft was driven at the latter at a cost of pumping 8,000,000 gal. of water daily. After spending $5,000,000, disaster to the pumps closed down the Tombstone mines in June, 1909, and all Murphy's mining interests failed. Murphy built a home for the Yavapai Club in Prescott and gave a zoölogical garden and park to the city. At Phœnix he controlled the Arizona "Republican," for about 12 years. He built a hotel at Castle Hot Springs and established a winter resort there. He was active in politics as a conservative Republican and contributed heavily to the party's funds. Of attractive personality, combined with forceful business and administrative ability, he is said to have brought into Arizona for investment more money than any other citizen.

Societies

The American Institute of Chemical Engineers held its ninth semi-annual meeting on June 20-22 at Buffalo, N. Y.

The American Society for Testing Materials held its 20th annual meeting at Atlantic City, N. J., on June 26-29. Its program, extending over 10 sessions, included 64 numbers.

The Merchants' Association of New York has elected the following officers for the ensuing year: President, William Fellowes Morgan; first vice-president, Lewis E. Pierson; second vice-president, James G. White; third vice-president, William Hamlin Childs; treasurer, Silas D. Webb, and secretary, S. C. Mead.

American Electrochemical Society held a meeting of its Board of Directors on May 25, at which many new members were elected. The treasurer and secretary were authorized to invest $2000 of the cash balance on hand in U. S. Liberty bonds. Various technical committees were appointed and confirmed.

New Patents

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

Amalgamation-Mill. David L. Penrod, Alta, Utah. (U. S. No. 1,230,770; June 19, 1917.)

Amalgamator. William W. Dill, Seattle, Wash. (U. S. No. 1,230,135; June 19, 1917.)

Casting-Machine. Henry Alinder, Milwaukee, Wis., assignor to Allis-Chalmers Manufacturing Company, Milwaukee, Wis. (U. S. No. 1,230,360; June 19, 1917.)

Casting-Machine. Charles Henry Lister, North St. Paul, Minn. (U. S. No. 1,230,587; June 19, 1917.)

Drafting—Drawing-Board. Wilbur L. Fulton, Omaha, Neb. (U. S. No. 1,230,398; June 19, 1917.)

Drilling—Forming Die. Oscar C. Julien, Montreal, Wis. (U. S. No. 1,230,303; June 19, 1917.)

Drilling-Machine. Henry Dreses, Cincinnati, Ohio. (U. S. No. 1,230,386; June 19, 1917.)

Gold—Subaqueous Gold-Saving Apparatus. Samuel Caldwell, Oakland, Calif. (U. S. No. 1,230,274; June 19, 1917.)

Heat-Insulating Material and Method of Making Same. Charles E. Hite, Philadelphia, Penn. (U. S. No. 1,230,297; June 19, 1917.)

Hydrometallurgy—Method of Treating Ores or Metal-Bearing Products. Frederic A. Eustis, Milton, Mass. (U. S. No. 1,230,143; June 19, 1917.)

Ingot-Mold. Samuel E. Hitt, Elyria, Ohio, and Joseph I. Peyton, Johnstown, Penn. (U. S. No. 1,230,405; June 19, 1917.)

Ore Classifying and Sizing Mechanism. Joseph Franz and Frank Franz, Wallace, Idaho. (U. S. No. 1,230,697; June 19, 1917.)

Ore Separator—Jig. Robert Hallowell Richards, Boston, Mass. (U. S. No. 1,230,433; June 19, 1917.)

Ore-Separator. Ephie Cohen, Joplin, Mo. (U. S. No. 1,230,674; June 19, 1917.)

Quarrying—Stone-Cutting Machine. Leonardo Filotico, Manduria, Italy. (U. S. No. 1,230,696; June 19, 1917.)

Refractories—Furnace-Lining and Method of Making Same. George W. Patnoe, Maple Grove, Ohio, assignor, by mesne assignments, to The Dolomite Products Company, Cleveland, Ohio. (U. S. No. 1,230,430; June 19, 1917.)

Smelting—Art of Fusing Ores. Raoul Pierre Pictet, Paris France. (U. S. No. 1,230,431; June 19, 1917.)

Editorial Correspondence

SAN FRANCISCO—June 21

Gold-Dredging Operations of the Natomas company of California, in 1917, will net $1,000,000 according to estimates just made covering the first half of the year. Including the land resoiled by No. 1 and 4 dredges, coincident with the recovery of the gold, there are 10 dredges operating in the American River division and the 3 dredges operating in the Feather River division. The company has taken from the net earnings of the two fleets of dredges the money essential to the reclamation of 90,000 acres of land to agricultural uses. It is anticipated that the crops of the ranches that are under cultivation will amount to a total of $500,000 in the season of 1917.

Title to Magnesite Claims in Santa Clara and Stanislaus counties have been awarded to the Western Magnesite Development Co. by Judge Van Fleet in the Federal Court. The property is estimated to be worth $250,000. The suit was brought by Hugh E. Stock of Nevada, one of the largest stockholders against James J. Cummings, president of the company and his son James J. Cummings, Jr., Thomas H. Wolfe, secretary and Joseph E. Stock, son of the plaintiff. Plaintiff charged that his own son and the three co-defendants conspired to defraud the company by failing to do assessment work to the amount of $5000 for which plaintiff furnished the money, and through failure to do the assessment work relocated the claims on which the work should have been done and located 10 other claims. The court ordered the 12 claims deeded to the company.

War Problems in Chemistry will be studied by the University of California department of chemistry which will contribute the labor of 30 members during the summer on problems presented by the Federal Government and the California State Council of Defense. The men volunteering their services have signed an agreement not to use their inventions and results of their researches for private gain and that all patents obtained for inventions will be assigned to the board of regents and all royalties will go to the University to create an endowment fund for scientific research. Several inventions now under way are said to be of importance and have already been transmitted to the U. S. Navy for consideration. Prof. Gilbert N. Lewis is head of the department of chemistry; Joel Hildebrand is industrial chemist and Edmond O'Neill is director of the laboratories.

Fuel Famine in California and the entire West is stated by Southern Pacific officials to be a possibility and they advise that steps be taken by the public at once to avoid all waste and conserve every possible source of supply of wood and coal and oil. The dearth of coal it is said is due to shortage of labor in the coal mines in the country, shortage of ships for coastwise and foreign coal and lack of equipment for railroad transportation. The Union Pacific Coal Co. has withdrawn from the commercial market. Railroad orders placed last August have not been filled and there is scarcely any reserve supply of coal on the Pacific Coast, what is available is likely to be required by the Government. The wood situation is so serious that the Southern Pacific has issued instructions to reclaim all scrap piling, ties and second-hand lumber along its lines. Fuel oil also presents a serious problem and it is upon this fuel that most of the transportation and large industrial concerns are dependent. W. R. Scott, vice president and general manager of the Southern Pacific company states that the company burns in its engines about 40,000 bbl. of oil a day and that the reserve supply is almost exhausted. Pending the result of location, it has asked the Federal court for permission to increase the production by drilling upon its own land in order to obtain sufficient fuel to handle its business. In this application the company agreed that the increased oil produced from the naval petroleum reserve would be delivered to the Navy on demand, should it be held that the Government has any right in the lands in question. The company is proceeding with drillings on lands outside of the naval reserve, but immediate relief of the situation is said to be impossible.

BUTTE—June 26

(By telegraph)

Butte Labor Situation is daily becoming more serious and tonight the outlook is that there will be a general shutdown of the mines in Butte and the smelteries at Anaconda and Great Falls. The demands of the strikers are so unreasonable and impossible that it is generally recognized that the purpose of the men behind the move is to shut down the mines and stop the production of copper and zinc. On pretense that nonunion electricians were doing work of striking electricians who went out against Montana Power Co., the strike committees succeeded in calling out machinists, boilermakers and blacksmiths at the Anaconda, Butte & Superior, East Butte and Clark properties. Wednesday night, hoisting engineers will meet and vote on question of supporting the strikers and if support is given it will result in general shutdown as managers declare they will not recognize the new I. W. W. union of miners, nor grant the demands of the electricians. Senator Clark in conference with W. H. Rodgers, Federal mediator, declared that before recognizing anarchistic union he would close his mines, let them fill with water and never hoist another pound of ore. Mill and smeltermen's union tonight endorsed miners strike and voted to surrender its charter in American Federation of Labor and unite with I. W. W. union. Silver Bow Trades and Labor Council, central labor body of Butte, also endorsed the striking miners. Strikers have refused all suggestions of arbitration or even conference with Montana Power Co. and declare they will fight it out their own way. All action of the unions is in defiance of the national regulations and of American Federation of Labor by which all of them are chartered. The national officers of the unions are arriving in Butte to help straighten out affairs.

DENVER—June 21

Serious Labor Shortage throughout the mining districts of the state has greatly interefered with the work of the mines and the mills this season. Numbers of miners have enlisted in the army and navy and some of the best mechanics have quit and gone to work in the United States navy yards. The situation will be still more serious when selection is made for the new army. Unless some exemption is granted. Colorado's production of metals, essential to the prosecution of the war, will be greatly curtailed. Gold-mining companies are particularly hard hit because their costs are going up at an alarming rate while there is no corresponding increase in the selling price of their products. During the last two years the cost of standard supplies used in and about gold mines and milling plants has increased 50 to 200% and no relief is in sight. A meeting of the executive committee of the Colorado Metal Mining Association was held on June 11 to consider the acute labor shortage and a resolution was adopted favoring the exemption from military service of all employees in the metal-producing industries. Congressman Taylor, vice-chairman of the mining committee of the House of Representatives, was requested to take up the matter with the proper authorities at Washington, and the various mining organizations in the metal-producing states were urged to line up their congressional delegations in support of the measure. The movement in favor of the measure to suspend all assessment work on unpatented mining claims until after the war, in order that this labor may be employed in production, has met with unanimous support throughout the mining districts of the West.

SALT LAKE CITY—June 21

Uinta Land Sale opened at Provo on the morning of June 18. Most of the land is suitable for grazing purposes, and the government is offering it at from 50c. to 75c. an acre. There are 1632 tracts which vary in size from 40 to 320 acres and no person may purchase more than 640 acres. Lands classified as oil and nitrate, or withdrawn as phosphate lands, will be sold with a reservation of the mineral deposit.

Strike at International Smeltery still continues and Federal officials are to visit Tooele. John McBride, coming as the representative of the Secretary of Labor, is expected shortly. The strikers, who are of many nationalities, have held various meetings, listening to speeches in the different languages represented. These meetings have been attended by W. M. Knerr, of the state industrial commission, who has been in Tooele since the beginning of the strike. Saloons have been closed, and there has been no disorder.

CLIFTON, ARIZ.—June 21

Another Labor Strike is being stirred up in this district. J. L. Donnelly, president of the State Federation of Labor, who was the principal force behind the abortive Jerome strike, has been a visitor here of late. He is said to have been authorized by 14 locals, with nominal membership of 4000, to make public their demands for abolition of the contract system, seniority rule in the employment and discharge of workmen, time-and-one-half for men who work overtime in case of emergency and for the establishment of the Miami wage scale. In addition to these, it is understood there will be demanded recognition of the union, company collection of union dues, a sharp reduction in store prices and a free supply of fresh water underground. Donnelly has been quoted as stating that the contract system "develops the individuality of the worker to the detriment of his collective interests." The Mexican worker, of whom there are many in this district, generally prefers to contract. The closed shop, it is considered, is one condition that never will be granted by the three operating companies. It is told that the stockholders in the Arizona Copper Co., Ltd., a Scottish company, are so heavily taxed at home on their copper profits that they would about as soon close down their plant as not, provided their property were given some degree of protection.

WASHINGTON—June 23

The Explosives Bill, which will soon come before the Senate, will be carefully considered by the committee on mines and mining. It expects to go exhaustively into the tentative regulations which have been drawn up by the U. S. Bureau of Mines in anticipation of the passage of the bill. C. F. Kelley, of the Anaconda Copper Mining Co., who had intended to appear before the committee to tell of the experience of his company with the pilfering of explosives, was prevented from being present. It is the idea of Van H. Manning, the director of the Bureau of Mines, to secure a volunteer of the Hoover or Peabody type who will be willing to take charge of the administration of the explosives regulations at a salary of $1 a year. In addition it is the intention to divide the country into four regional departments. Each department will be under the direct supervision of a dollar-a-year volunteer. New York, Chicago, Denver and San Francisco are mentioned by Mr. Manning as the probable points from which the departments will be administered. In addition it is planned to have state and territorial headquarters, in each of which there will be a supervisor. The supervisors, of which there will be 49 in number, will receive a salary of $1800. Before the regulations are drawn up finally, Mr. Maning proposes to submit them to a conference to be attended by 40 or more persons representing all interests that will be affected. Mr. Manning suggests that the regulations should not be adopted until they have been passed upon by representatives of the operators of metal mines, coal mines, quarries and other industries using explosives in quantities; representatives of the United Mine Workers of America, Western Federation of Miners, National Safety Council and of interested municipalities. In addition manufacturers of explosives, as well as jobbers and retailers, will be asked to send representatives to the conference.

Intimations of Government Operation of mines and the insistence of the administration to determine costs of production for itself have had a disquieting influence on a number of industries. The produc-

tion-cost probe is to extend to copper and iron ore, as well as to coal, oil and cement. No great amount of faith is expressed by mining men here in the ability of the Federal Trade Commission to arrive at the correct solution of so intricate a problem as is the cost of production. There has been a tendency to disregard the extensive evidence presented by the operators showing their costs. That the administration contemplates drastic action is shown clearly by the following statement made by Francis S. Peabody, of the committee on coal production. It may be considered with equal timeliness as to copper and to iron ore. Mr. Peabody said: "Unless some regulation is made as to the present high price of coal by the coal men themselves, the government is going to step in and do it for them. It is not pleasant for me to say this but I know what is going to be done. It is much better that we should willingly get together and confer with the broadminded men on the Federal Trade Commission and discuss this matter with our cards on the table, than for some man to be given the authority to tell us the price for which we are going to sell coal, or, if it comes to the worst, for some government official to take charge of our mines. I know this will be done, if we do not do it ourselves." Mr. Peabody made this statement reluctantly as he did not desire to add further to the widespread uncertainty. Conditions must be faced, however. The attitude of the Secretary of the Navy is indicated when he declared formally that "there is no justification for a tremendous increase in the prices of basic materials. The Almighty put these things in the ground and the only additional costs over normal times is in getting them out." Continuing, he said: "When the Trade Commission has made its report on the cost of production, reasonable profit will be added and the price will be fixed after we have a full knowledge of costs."

JOPLIN, MO.—June 23

Lower Royalties to offset increased production costs are being urged here as the only recourse that may be expected to keep the thin sheet-ground mines operating. There has been another rise in hard iron during the last week, and increases in the price of pipe, tracking, steel, and powder have been numerous. A few years ago hard iron could be purchased for $2.50 per hundred, now it is $4.50. Ore buckets that used to cost $11 now cost $23, and the low-grade sheet-ground mines require many of them. Tracking, formerly costing $1.60, now costs $4.25. Steel that used to sell for $1.10 now brings $2.20. Coal that formerly could be purchased at the mines in Kansas for $1.25 per ton, now costs $3 and it is impossible to contract for any amount at this price. Powder that formerly could be obtained for $9.75 per hundred now costs $30.75, with fuse and caps correspondingly advanced.

Development in the Waco Camp, northwest of Joplin, continue to indicate unusually rich prospects. The American Metal Co. has a lease on what is known as the Liberal mine there, where a new shaft has just been put down. From the depth of 50 ft. to 134 the dirt taken from the shaft gave an average return of 7% of blende. For a part of this distance the milling of the ore in a custom mill gave a recovery of a fraction less than 25% of blende. In the last few weeks drill holes have been brought in near Waco that are as rich as any ever recorded in the Oklahoma section of the field. Where a year ago only one concentrating plant was being planned, sites for nine have now been blocked out and many new mills will be in operation in the camp within the next six months. Part of the orebodies are found on the Missouri side and part in Kansas, and the turn-ins will doubtless be divided between Waco, Mo., and Lawton, Kansas.

TORONTO—June 23

Government Will Run Coal Mines in western Canada. To secure the prompt operation of the coal mines in the Crow's Nest Pass region, the Dominion government announced, on June 22, that W. H. Armstrong, of Vancouver, had been appointed as commissioner to operate the mines, or to direct the owners to do so, under the war measures act. Work is to be resumed, but it is assumed that the proposed penalty of $1 per day against the miners—which the operators stood out for—will not be enforced. Shortage of coke in this region caused the closing of the copper smeltery of the Granby Consolidated Mining, Smelting and Power Co. at Grand Forks, B. C., and caused serious inconvenience at the Trail works of the Consolidated Mining and Smelting Co., though the latter company succeeded in keeping its plant in operation.

Labor Situation at Porcupine is gradually becoming less acute, and the prospect of a strike is diminshing as a result of amicable conferences between the mine owners and their employees. The McIntyre, in response to requests of a deputation representing their own men only, agreed to grant them an allowance of 50c. per day to continue so long as cost of living, as shown by the reports of the Dominion Food Commission, remains higher than in August, 1914. All other bonuses are discontinued. The officials of the Porcupine Crown, Vipond and Schumacher have also been in conference with representatives of their employees, but the result has not yet been announced. The Dome Mines has intimated its willingness to hear complaints from its employees. The Tough Oakes of Kirkland Lake has granted the 50-c. allowance under same conditions as the McIntyre. The position of the companies that, while willing to confer with their own employees, they will not recognize the union, appears to be accepted by the men.

The Mining News

ALASKA

COPPER ORE SHIPMENTS in May amounted to 17,710 tons, containing 7,146,824 lb.

ARIZONA

Cochise County

MASCOT (Wilcox)—Reported leased by American Smelting and Refining Co.

Gila County

NEW DOMINION (Globe)—Copper ore, ranging from 6 to 10%, is being shipped to Old Dominion smeltery from the old Mallory mine. Twenty-five men are employed.

MIAMI COPPER (Miami)—A 60-day stay has been secured in the Minerals Separation flotation decision, by agreement of counsel and filing of $200,000 bond.

Graham County

INSPIRATION CENTRAL (Geronimo)—Shipments from this property in Black Rock mining district will be begun July 1. A 14-mile road completed from mine to Arizona Eastern Ry. Body of shipping ore recently opened in tunnel.

Greenlee County

ARIZONA COPPER (Clifton)—May production was 5,200,000 lb.

Mohave County

UNITED EASTERN (Oatman)—During May milled 7802 tons, an increase of 29 tons per day over record for April. Average value $17.10 per ton, recovery 96.12%. New compressor contemplated.

Pinal County

TROY ARIZONA (Kelvin)—Climax shaft now down 225 ft.

PINAL DEVELOPMENT (Kelvin)—Bottom of new winze in good ore.

RAY SILVER (Ray)—Nearly 200 burros taking ore down to railroad.

GILA DEVELOPMENT (Kelvin)—At 210 ft., some excellent ore encountered. Flow of water increasing.

Yavapai County

UNITED VERDE (Jerome)—Again operating at practically full capacity. New bunkhouse being built at entrance to Hopewell tunnel.

TIP TOP (Prescott)—C. B. Hollinger & Co. of Los Angeles have taken control. Agree to liquidate present indebtedness and do development. First work will be to unwater 800-ft. shaft.

BRADSHAW REDUCTION CO. (Crown King)—New mill working satisfactorily, making much better recovery than old plant. Installing tramway to Wildflower mine. Company expects to treat tailings of Old Tiger mill after remodeling that plant. D. H. Gemmill, manager.

COPPER HILL (Skull Valley)—Lately taken over by Garford interest, which are also operating the Jackman & Withers molybdenite mine near Kingman in Mohave County. Shipments starting from Copper Hill group which consists of 10 claims. In charge of George M. White, general manager of Arizona Sampling and Reduction Co. at Wickenburg.

Yuma County

SWANSEA LEASE (Swansea)—Employees at this copper mine, recently taken over by the Clarks, went on strike for the Miami scale, which was immediately granted by Charles W. Clark who was on the property at the time.

CALIFORNIA

Amador County

LINCOLN CONSOLIDATED (Sutter Creek)—Third payment reported to have been made under purchase option held by Eastern men—said to be associated with the owners of the Old Eureka. The property includes the Wildman and Mahoney, adjoins the Old Eureka on the north and underlies the principal portion of the town of Sutter Creek. In the early days of Amador County, these mines were among the large producers but like many other mines on the Mother Lode were abandoned when it became necessary to expend money for development. Consolidation of the Lincoln Consolidated and the Old Eureka considered probable. Payments so far on the Lincoln Consolidated are said to have amounted to $123,000; the price is approximately $200,000.

Calaveras County

BUMSTED (Murphy)—Electric hoist contemplated at this prospect.

ROYAL CONSOLIDATED (Hodson)—Reported that indebtedness is settled and mine will resume.

SAFE DEPOSIT HYDRAULIC MINING CO. (San Andreas)—Permitted to sell 12 shares at par $250 per share for further equipment.

SAFE DEPOSIT (Mokelumne Hill)—Hydraulicking resumed under new management after idleness of a month; employing 12 men and using 700 in. of water.

DENSLOW (Murphy)—Mine reported optioned by a Mr. Folsom of Stockton. Crosscut tunnel will be driven to orebody. T. G. Denslow, owner.

HODSON MINES CO. (Hodson)—Permitted to issue 20,000 shares capital stock of $1 par value to C. M. Brown for purchase option on Mountain King mines in Felix mining district.

MOHAWK (Angels Camp)—Installation of mill completed; will install electric plant for driving mill and machine drills. New shaft will be sunk and crosscut run at 100-ft. point. F. M. Raymond, manager.

CALAVERAS CONSOLIDATED (Melones)—Results from 3-stamp sampling mill having proved satisfactory, first 10-stamp unit of 30-stamp mill of 1250-lb. stamps is being installed. Stamps installed because quicker delivery is expected than for ball mills. Vein at 1250-ft. level is 24 ft. wide, carrying ore averaging $4 a ton. Main tunnel in 2200 ft.; payable ore cut in several places. W. J. Loring, manager.

Eldorado County

NEW TOWN GRAVEL MINING CO. (Oakland)—Permitted to sell 3000 shares for development of Gardella-Tecchino gravel mine, optioned at $8000, payable Jan. 1, 1919.

GROZIER (Placerville)—High-grade ore disclosed in 300-ft. tunnel at depth of 150 ft. below surface. Mine on Whaler Creek, Mosquito district. Owned by Gus Grozier.

HOLLEY (Placerville)—Property, formerly called the Lemon, being developed with 10 men. Adjoining property also be-

ing developed and sampled with two-stamp mill. Compressor will be installed and the two properties will be operated as one. High-grade ore recently disclosed in a 35-ft. stope.

Inyo County

SALINE VALLEY BORAX resources again being investigated, by S. A. Knapp of San Francisco. Probability that property will again be worked.

STANDARD (Bishop)—Fifteen tons of 65% tungsten concentrate shipped on June 11 to Latrobe, Penn.; value of shipment about $20,000. Similar shipments made from Tungsten Camp, where the Tungsten Mines Co. also operates.

CERRO GORDO (Keeler)—In first quarter, receipts were $205,381; operating expense, $45,760; operating profit, $159,621. Mined 4877 tons, of which 2371 tons were zinc ore containing 1,501,264 lb. of zinc and 2506 tons of lead-silver ore containing 29 oz. gold, 47,559 oz. silver and 1,646,366 lb. lead. Shipped old slag, 2934 tons, containing 8781 oz. silver and 664,244 lb. lead.

Kern County

SLATE RANGE MINERALS CO. (Bakersfield)—Permitted to issue 50,000 shares to B. N. Trueman and others in exchange for claims in Slate Range district, Searles Lake region.

McNALLY SILVER (Mariposa)—Situated in Bootjack district; will be reopened by J. B. Freeman under purchase option. Unwatering.

Nevada County

LE DUC GOLD MINING CO. (Grass Valley)—Permit to issue 40,000 shares common stock to members of former copartnership for options and mining equipment; to sell common stock to secure $25,000 for development.

Siskiyou County

SISKIYOU SYNDICATE (Etna Mills)—Preparations being made for development of the Blue Jean mine. Company owns Cub Bear and other properties in Salmon River district. I. J. Luce and A. Wright of Seattle are the principal stockholders and managers.

GRAY EAGLE (Happy Camp)—Extraction of ore greater than can be taken by smeltery at Thompson, Nev. Installation of flotation plant contemplated. Other copper properties in district are being developed. The Bon Ton group on Slater Creek; also the Mohawk and Copper King are being developed by M. A. Delano of Grants Pass, Ore.

Stanislaus County

GOLD DREDGE installation at Knights Ferry in progress by A. H. Hadsell and associates of Los Angeles. Dredge will operate on ground leased of Dan Mann, formerly operated by ground sluicing and hydraulicking.

Tuolumne County

EAGLE-SHAWMUT (Shawmut)—Deepening main shaft has reached 2200-ft. point. Drift on No. 17 level being advanced steadily in good ore. Electric hoist will be installed, capacity three tons at 1000 ft. per min. Reported that chlorination plant, one of largest in state, will be dismantled and that cyanidation or flotation will be employed. New surface improvements include club room for employees. Controlled by Tonopah-Belmont Development Co. G. F. Williamson is superintendent.

COLORADO

Boulder County

GREAT BRITAIN (Wall Street)—Mine being opened by New York men; mill will be built. Ore carries gold, silver and bismuth.

NEW GOLD DISCOVERY, six miles east of Ward; shoot of good-grade ore opened in vein along Colonial dike.

UNITED STATES GOLD CORPORATION (Boulder)—This cyanide plant in Sugar Loaf district again treating custom ores, causing considerable revival of mining.

Clear Creek County

EMPRESS (Freeland)—Work begun under direction of Robert Hastie.

ARGO MILL (Idaho Springs)—The plant is running at full capacity. About $2000 worth of ore purchased daily mainly from properties developed from the Newhouse Tunnel. Rich ore recently received from lessees on the Edgar.

Dolores County

RICO CONSOLIDATED (Rico)—Steady shipments of iron-copper ore being made to Leadville. Wagon road being put into shape for larger production.

RICO MINING (Rico) — Considerable shipping-grade ore being produced from Syndicate mine on Newman Hill; extremely high-grade ore taken from small shoots.

Ouray County

AMERICAN NETTIE (Ouray) — Old dumps being retreated.

CAMP BIRD (Ouray)——Yellow Rose vein cut by new tunnel; vein 25 ft. wide. With cutting of this vein, flow of water again increased to maximum yet opened. Yellow Rose is sixth vein cut to date; other well-known veins to be cut before tunnel reaches Camp Bird vein are Buckeye, Girl-Conqueror. Roosevelt-Imogene and Pocahontas-Hidden Treasure. Latter is very wet and big flow expected from it. Development work on new veins will not be done until tunnel has reached its objective point.

Park County

LING (Alma)—New tunnel to be driven to develop this old mine at greater depth.

HOCKHOCKING (Alma)—Mill construction resumed; mixed sulphide ore.

MAGNOLIA (Alma)—Will be worked by leasing company. Old Eddy mill repaired and cyanide plant installed. Operations to begin as soon as 4000-ft. tramway from mine to mill is repaired.

LONDON (Alma)—Exceptionally high-grade ore being shipped. Several sacks stolen in transit; arrest made. Lessees working with good success. New development being done in South London mine; shipments made.

Summit County

HAMMER (Breckenridge) — Shoot of good-grade lead ore opened in tunnel and winze. Contract let to drive new tunnel.

FOREMOST (Frisco) — Development work resumed on this property adjoining King Solomon mine. Ore opened in two tunnels last autumn; shipping to begin soon.

MUTUAL GOLD MINING CO. (Breckenridge)—Recently incorporated; will drive crosscut tunnel to open veins at depth on North Star Mountain in upper Blue River district.

Teller County

STRONG (Cripple Creek)—Shaft sinking resumed and will be continued to water level.

RAMONA (Cripple Creek)—Lease and option taken on this Bull Hill property and work started.

TRILBY (Cripple Creek)—Regular shipments being made by lessees from above 600-ft. level.

EL PASO (Victor)—Fifteen sets of lessees working; shipments average one car per day of 1 oz. gold ore.

SIX POINTS (Cripple Creek)—Lessees on this Stratton Estate property on Bull Hill shipping good-grade ore.

GOLD DOLLAR (Cripple Creek)—Lessees making shipments of 2-oz. gold ore from recent developments on 400- and 600-ft. levels of Mable M shaft.

OCEAN WAVE (Cripple Creek)—Sinking two-compartment shaft. Three-year lease held from Portland company on Ocean Wave and Little Mary claims.

GOLD BOND CONSOLIDATED (Cripple Creek)—This Gold Hill property being developed through Hummer shaft by F. L. Wilcox, under lease and bond. Payable ore opened and a carload shipped.

IDAHO

Bear Lake County

WESTERN PHOSPHATE MINING AND MANUFACTURING (Paris)—Expects soon to begin production of high-grade phosphate rock. Tunnel has reached outer zone of deposit. Hydro-electric plant built near tunnel portal. L. A. Jeffs, Salt Lake City, Utah, consulting engineer.

Kootenai County

COMMONWEALTH MINING (Hayden Lake)—This old property, taken over last autumn, will have a mill if development shows ore at the 400 level; on 200-ft. level vein shows 8 ft. of shipping ore; 24 ft. of milling grade. Shaft being deepened. Ernest C. Wood, superintendent, 401 Empire State Bldg., Spokane, Wash.

MICHIGAN

Copper

OSCEOLA Osceola)—Shipping over 3750 tons daily.

MASS (Mass)—Producing 900 to 1000 tons per day. Slight increase; still need men.

NEW ARCADIAN (Houghton)—Sinking its shaft to 3000 ft.; now bottomed at 1500-ft. level. New compressor now in operation.

FRANKLIN (Demmon)—Hoisting over 1100 tons last few days. Reopening No. 2 shaft to 17th level proving difficult because of extensive caving; some drifts entirely caved.

COPPER RANGE (Painesdale)—Output of Trimountain mine will show immediate increase as result of operations at the 14th, 22nd and 23rd levels, where electric locomotives have been installed.

MAYFLOWER-OLD GLORY (Calumet)—Starting new shaft; passed through the overburden (12 ft. thick) and have drilled 4 ft. in rock. Shaft is to have three compartments. The machinery from old workings will be utilized; second-hand hoist purchased.

CALUMET & HECLA (Calumet)—Copper production for May for C. & H. and subsidiaries was: Calumet & Hecla, 6,879,012 lb.; Ahmeek, 2,476,542; Allouez, 885,649; Centennial, 165,282; Isle Royale, 1,336,575; La Salle, 141,384; Osceola, 1,403,019; Superior, 160,065; Tamarack, 619,573; White Pine, 382,910 lb.

VICTORIA (Victoria)—The 27th level, bottom, has for the distance it is opened both ways, about 140 ft. high-grade stamp rock and some mass copper. The 23rd, 24th and 26th levels showing commercial ore. Planned to build about 25 new houses in order to attract married men into district. All work lagging behind because of lack of men.

LAKE MILLING, SMELTING AND REFINING CO. (Point Mills)—Has ordered its new mill motors, including eight 50-hp. motors for Hardinge mills, one 50-hp. motor as spare; eight 40-hp. motors for rolls and one for spare; two 20-hp. motors for shops; one 40-hp. motor for pumping; two 150-hp. motors for stamp heads and valve gear; one 250-hp. motor for stamp heads, one 1000-hp. motor for pumping; also necessary transformers and switch apparatus.

Iron

OLD NORRIE (Ironwood)—Lessees now hoisting ore. Property idle several years. Removing ore left in mine but hope to find additional orebodies.

FORBES (Iron River)—Mine closed but pumps will be kept in operation. Much ore in stock but little sold; not wanted by furnaces at this time; too high in phosporous.

BRISTOL (Crystal Falls)—Likely that mine will be closed down. One shift already laid off. Big stock of ore on hand; little sold. Mines getting out high-phosphorus ore experiencing difficulty in getting rid of their stocks. One of the large soft-hematite mines on the Marquette Range may close in a few weeks. The bessemer grades are more in demand for munition purposes.

MISSOURI

Joplin District

OSCEOLA (Webb City)—Building new 150-ton mill.

LACLEDE (Miami, Okla.)—New mill west of Tar River, Okla., completed.

A. R. G. (Joplin)—Moving 400-ton mill from Duenweg to new site near Treece, Kan., northwest of Picher, Oklahoma.

HARTFORD (Joplin)—Moving concentrating plant from Neck City to lease recently drilled on Whitsett land at Carthage.

CUMBERLAND (Joplin)—No. 2 mill of this company, owned by F. C. Wallower, being moved to site on Dardene land, just south of Baxter Springs.

O. & M. (Webb City)—Completing 500-ton mill on Baker land, north of city. Nordberg engine being installed. Have 50-acre lease. Thomas Walker, manager.

D. C. & E. (Webb City)—First car of concentrates from new mill on No. 4 property sold during week. Assayed 63.40% metallic zinc. Ore averaged 3½% blende recovery. J. J. McLellan, manager.

T. F. COYNE (Webb City)—Has drilled two tracts in new Waco field. Out of total of eight drill holes on one forty- and one eighty-acre tract, has seven good holes showing face ranging from 105 to 120 ft.; drill entered ore at 130 and remained in it at most holes to 250 ft. One hole showed 42% of blende.

LUCKY JACK (Joplin)—Building new mill on Hocker land, south of Baxter Springs; capacity 600 tons in 24 hours. One shaft now sunk into ore, which comes in at 97 ft.; second shaft down 90 ft. Drilling showed ore persisting to 200 ft. level, with lead at shallow level. George K. Williams, manager.

VINEGAR HILL (Baxter Springs, Kan.)—Has sold mine and mill at Cave Springs to Budd M. Robinson. Consideration not made public but offer of $125,000 was refused month ago. Robinson will add a shaft on his own property, which adjoins, and expects to be working big sheet-ground mill to full capacity at once. Operations carried on from 80 to 200 ft. Vinegar Hill Co. recently placed new mill in operation north of Commerce, Mo., and will have new 1000-ton mill on Barr land, in Kansas, just north of Picher, Okla., in operation in near future. S. H. Davis, Baxter Springs, manager.

MONTANA

Lewis and Clark County

STANTON (Rimini)—Driving tunnel, and ore shipments are going out. Lead and zinc. P. T. McDermott, superintendent.

BACHELOR (Stemple)—Raise at face of 1400-ft. crosscut tunnel completed. Free milling gold ore to be sent to Lane mill near tunnel mouth by July. Superintendent, Willey.

HELENA MINING BUREAU (Helena)—Shaft finished 300 ft. deep. Drifting on 300. One car of ore shipped from this Grass Valley mine to smeltery. Stoping to begin soon. Superintendent, Cupples.

VALLEY FORGE (Helena)—Ore dump being transported by rail to New York-Montana Testing and Engineering plant at Helena. Concentrates sent to smeltery at East Helena. Twenty-nine carloads transported last month. Seven cars concentrates recovered. Frank Eichelberger, manager.

Silver Bow County

STRIKE CONTINUES at Butte mines without much change in the situation, though a few more men are reported to be working.

NEVADA

Clark County

PLATINO (Goodsprings) — Strike of platinum-bearing ore reported recently in new shaft. Initial shipment of copper ore from this property was made this month.

BOSS (Goodsprings)—New testing plant for copper-gold-platinum ore was successful in extracting metals, but owing to high cost of fuel and chemicals, will erect permanent plant at Los Angeles and ship ores. Plans being made by Pacific Platinum Works of Los Angeles which expects to receive shipments within 60 days. Some high-grade platinum ore now being shipped to eastern smelteries, and about 200 tons of copper ore monthly to Garfield. Ore containing copper and platinum recently discovered on fourth (lowest) level.

YELLOW PINE (Goodsprings)—Important strike made on 700-ft. level, where orebody averaging 20 ft. wide has been exposed for 100 ft. Ore is of unusually high grade, averaging 18% lead, 32% zinc and 25 oz. per ton. Strike was made at extreme north limit of mine in virgin territory, and consequently is of much importance. Two Overstrom Universal concentrators have been added to mill equipment and company is now shipping about 1500 tons of zinc concentrate and 300 tons of lead concentrate monthly. Regular monthly dividend of 3c. per share, with extra dividend of 3c. declared payable June 25, making total this year $210,000. Recently subscribed $50,000 to Liberty Bond issue.

Esmeralda County

GOLDFIELD FLORENCE (Goldfield)—Negotiations now under way may pass control to Red Hills Florence company. Property has been in hands of receiver about eight months.

SILVERMINES CORPORATION (Hornsilver)—Mill under cover and machinery being installed. Will be in operation about Aug. 1. S. H. Brady, 302 Nixon Bldg., Reno, president.

JUMBO EXTENSION (Goldfield)—After penetrating about 200 ft. of alaskite which showed no indication of continuance of vein system, core drilling below the 1017-ft. level abandoned. Occasional shipments of good-grade ore being made.

Lyon County

KENNEDY CONSOLIDATED MINING CO. (Ludwig)—John F. Cowan and Salt Lake associates have taken over this copper-gold-silver property in Buckhorn Range, about five miles from Ludwig. Flotation mill contemplated. Thirty feet of ore opened at 80-ft. depth; oreshoot exposed in three places over length of 300 feet.

Nye County

TONOPAH ORE PRODUCTION for week ended June 16 was 9117 tons, valued at $164,106, comparing with 8618 tons for previous week. Producers were: Tonopah Belmont, 2883 tons; Tonopah Mining, 1800; Tonopah Extension, 2380; Jim Butler, 700; West End, 1070; Rescue, 192; Montana, 36 and North Star, 54 tons.

ZANZIBAR (Manhattan) — Optioned by George Wingfield and associates. Wagon road being built to site of new shaft to be sunk jointly with White Caps Extension company.

Storey County

ANDES (Virginia)—Saved 117 cars of ore from 350-ft. level, averaging $8.60 per ton.

JACKET (Gold Hill)—Saved 341 cars of ore from Jacket surface tunnel. Repairs to shaft and alterations in mill continued.

SIERRA NEVADA (Virginia)—Ore disclosed in 2600-level drift toward Union ground, about 50 ft. from south line. Unexpected at this point.

CON. VIRGINIA (Virginia) — Cutting out for electric hoist and chutes on 2700 level, preparatory to sinking on the ore. Extracted 122 cars of ore averaging $12.42 per ton.

UNION CON. (Virginia)—Extracted 130 tons of ore averaging $11.18 from 2500 level; 36 tons from 2600 level averaging $39.80; total extraction, 166 tons, averaged $18.66.

MEXICAN (Virgania)—Mill ran on ores from Union, Mexican, Sierra Nevada, Con. Virginia. Shipped three bars bullion Mine work continued on 2000, 2700 and 2900 levels.

White Pine County

NEVADA CONSOLIDATED (McGill)—North half of new crushing plant went into commission June 1 and is running smoothly; crushing to minus ¾ in., while old crusher reduced to only about 3 in. The half unit is crushing up to 700 tons per hour; it will be 30 days before the other unit goes into commission, owing to delay in receipt of material.

SHORTAGE OF LABOR is beginning to be felt in White Pine County, where there has been surplus for number of years; many Greeks and Japanese have gone to eastern factories. Silver-lead mines in different parts of county are active; ores mined last winter are being hauled now from Hamilton, 45 miles west of Ely. Tungsten mining is inactive owing to reduced prices.

UTAH

Beaver County

MILFORD COPPER (Milford)—Stock recently listed on Salt Lake exchange. Shipments being made. Stated that connections with Salt Lake Route will be completed shortly, when output can be considerably increased and expenses reduced. Property consists of 18 claims

Salt Lake County

BINGHAM MINES CO. (Lark)—Initial dividend of 50c. per share will be paid July 2.

CARDIFF (Salt Lake)—Roads so far improved that this property—Big Cottonwood's largest producer—is shipping 75 tons daily; expected to increase output to over 100 tons daily. Four new tractors in operation.

Summit County

DALY WEST (Park City)—Mill resumed operations; suspended when water supply was frozen. Treating 100 tons daily.

ONTARIO (Park City)—Stated that company has arranged to mill second-class ore at Daly West mill; may eventually build a mill. Conditions on 1700 level encouraging.

PARK-UTAH (Park City)—This company soon to file articles of incorporation to develop eastern end of Park City district, held back owing to drainage difficulties in past. Arrangements made for drainage, operation, and transportation through Daly and Ontario tunnels. Owns large acreage. H. Otto Hanke will be president.

Tooele County

BUFFALO CONSOLIDATED (Ophir)—High-grade lead-silver ore being opened. Tunnel in over 1200 ft.; incline down 50 ft. in ore.

FOUR METALS (Salt Lake City)—This property in Dugway district—day's journey by automobile from Salt Lake City—reported sold to Eastern men. Arranging to haul by tractors. Roads good for eight months of year.

WESTERN UTAH COPPER (Gold Hill)—Oreshoot carrying lead, with some gold and copper, said to have been followed over 360 ft. downward at this property, largest producer in Deep Creek district. Maintaining shipments of 200 tons daily of copper ore running 5 to 6 per cent.

FERBER COPPER CO. (Salt Lake City)—District west of Deep Creek. Property being opened to greater depth in No. 1 and No. 3 shafts, especially; highest grade ore found there. Good ore in other parts of property. Recent strike of copper ore made in drift from No. 3 shaft being followed.

WISCONSIN

Zinc-Lead District

MUD RANGE (Potosi)—Small milling plant under construction.

DAVID (Montfort)—Drilling indicates good run of zinc ore ahead of old mine workings; now being operated by Hump Development Co.

BLOCKHOUSE (Platteville)—Sheet of ore 2½ to 3 ft. thick lately developed; making 50% concentrates. Company has 2000 tons of concentrates in bin; operates two roasters; ore range proved ¼ mile by drill.

HARMS (Platteville)—First three holes drilled by R. E. Davis and associates penetrated rich jack ground.

CANADA

Nova Scotia

NOVA SCOTIA STEEL AND COAL CO. (New Glasgow)—Increasing working capital by issuance of $5,000,000 common stock. Frank H. Crockard now president.

Ontario

ORE SHIPMENTS from Cobalt, over Temiskaming & Northern Ontario Ry. are reported by Arthur A. Cole, mining engineer, for month of May as follows: Beaver, 68 tons; Buffalo, 55; Coniagas, 121; Dominion Reduction Co., 305; Hargraves, 20; Hudson Bay, 42; Kerr Lake, 30; La Rose, 174; Mining Corporation of Canada, 31; McKinley-Darragh, 124; Nipissing, 117; O'Brien, 64; Penn Canadian, 60; Temiskaming, 43; Trethewey, 58; total for Cobalt proper, 1318 tons; Miller-Lake-O'Brien (Elk Lake) 52; total silver ore, 1371 tons; nickel ore from Alexo mine (Porquis Jct.), 448 tons.

LA BELLE KIRKLAND (Kirkland Lake)—Work temporarily suspended. Mine opened 350 ft.; considerable good milling ore blocked.

ASSOCIATED GOLDFIELDS (Larder Lake)—Shaft down over 400 ft.; following vein encountered at 300 ft. Machinery is being installed.

ELLIOTT-KIRKLAND (Kirkland Lake)—Will sink shaft another 100 ft. Development on 100-ft. level has not yet disclosed any commercial orebodies.

TECK-HUGHES (Kirkland Lake)—First monthly report issued on mill operations shows 1295 tons treated in May; average grade, $7.50. New vein, 4 ft. wide, crosscut under lake at depth of 200 ft.

McINTYRE (Schumacher)—Main drift at 1000-ft. level is in over 1100 ft. in good grade ores. Preparing to open mine to 1300-ft. level, with equipment capable of 2000-ft. depth. Diamond drilling from 1000-ft. level indicated 22-ft. vein at 1325 ft.; core officially stated to assay $20.50 a ton.

BEAVER (Cobalt)—Quarterly statement, May 31, shows bullion and ore in storage, at smelteries and at mine, containing 252,948 oz.; cash on hand, $49,916. On May 22, payment of $75,000 was made on the Kirkland Lake property, shaft of which is down 600 ft.; vein cut at that level, similar to exposure on upper levels. Oreshoot over 400 ft. long on 400-ft. level.

MEXICO

BOLEO (Santa Rosalia)—Copper production in May was 1,929,088 lb.; grade of ore 3.75%.

GREENE CANANEA (Cananea)—Mines and reduction works reported closed by local Mexican officials. Company's Eastern office has no definite information, except a dispatch stating that all American employees, who so desired, were permitted to cross the border. Last year when similar conditions prevailed, Mexican employees continued to operate properties at reduced capacity.

CHOSEN

ORIENTAL CONSOLIDATED (Unsan)—In April, 300 stamps ran 29¾ days crushing 26,451 tons for yield of $127,182; operating costs, $69,729; operating profit, $57,453; improvements, etc., $1800; net profit, $55,653.

The Market Report

Metal Markets

SILVER AND STERLING EXCHANGE

June	Sterling Exchange	Silver New York, Cents	Silver London, Pence	June	Sterling, Exchange	Silver New York, Cents	Silver London, Pence
21	4.7540	78	39⅜	25	4.7540	78½	39⅞
22	4.7540	78½	39⅞	26	4.7540	78	39⅜
23	4.7540	78½	39⅞	27	4.7540	78½	39⅜

New York quotations are as repoted by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

DAILY PRICES OF METALS IN NEW YORK

June	Copper Electrolytic	Tin Spot.	Lead N. Y.	Lead St. L.	Zinc St. L.
	29		11	11	9.10
21	@30	63¼	@11¼	@11¼	@9.20
	29		11	11	9.10
22	@30	63¼	@11⅜	@11⅜	@9.20
	29		11	11	9.10
23	@30	62½	@11⅜	@11⅜	@9.20
	29		11	11	9.10
25	@30	62½	@11½	@11½	@9.20
	29		11	11	9
26	@30	62½	@11⅜	@11½	@9⅛
	29		11	11	8¾
27	@30	62½	@11½	@11½	@9

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for the deliveries constituting the major markets, reduced to basis of New York, cash, except where St. Louis is the normal basing point.

The quotations for electrolytic copper are for cakes; ingots and wirebars. Electrolytic copper is commonly sold on "regular terms" (r.t.), including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.25c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for spelter are for ordinary Prime Western brands. We quote New York price at 17c. per 100 lb. above St. Louis.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1 cents.

LONDON

June	Copper Standard Spot	Copper Standard 3 Mos.	Copper Electrolytic	Tin Spot	Tin 3 Mos.	Lead Spot	Zinc Spot
21	130	129½	142	249	247	30½	54
22	130	129½	142	246½	244½	30½	54
23	...	...	...	...	...	...	...
25	130	129½	142	243½	239	30½	54
26	130	129½	142	244	239	30½	54
27	130	129½	142	...	....	30½	54

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb. For convenience in comparison of London prices, in pounds sterling per 2,240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21½c.

NEW YORK—June 27, 1917

All of the markets were dull this week, there being none of the metals in which transactions footed up to very much, but in all cases there was a weaker tone, resulting from the efforts of some tired holders to find levels at which they could make things move.

Copper, Tin, Lead and Zinc

Copper—There were several sales of one-million and two-million pound lots, for third quarter delivery, to domestic consumers. This business was done on the basis of 29½c. net cash, New York. However, the aggregate of all transactions did not amount to much. There were several inquiries in the market for copper for export and offers to sell round tonnages were made at reduced prices, but the business was not placed. The premium on near-by copper disappeared and at the end of the week there were sellers of spot and July at 30c., while August-September was to be had at 29½c. or less.

The street was full of gossip today about negotiations for supplying copper to the government and some business soon to be announced. We understand that a government order has, indeed, been placed; not, however, for a very large quantity.

Copper Sheets—The price of copper sheets has advanced a shade since last week. We quote hot rolled at 39@40c. per lb., cold rolled 1c. higher. Wire now quoted nominally 35c. f.o.b. mill.

Tin—This market was very dull and prices were a little lower.

Lead—Sales were again relatively light. The price realized for uncontracted lead gradually receded. One large seller that offered freely throughout the week at 11¼c., basis St. Louis, reduced its price to 11⅛c. today. At the close of the week the market for uncontracted lead is close to the price of the American Smelting & Refining Co. The most interesting feature of the week was the announcement of the sale of 8000 tons of lead, July delivery, to the government at 8c. per lb., the negotiations for which have been going on for a long time.

This communication has been sent to every lead producer in the United States by Clinton H. Crane, chairman of the committee on lead of the Advisory Council of National Defense:

"The committee on lead appointed by the advisory commission of the Council of National Defense has agreed on behalf of the domestic producers of lead to furnish 8000 tons of pig lead between now and Aug. 1 to meet the requirements of the United States Government. The price set for this tonnage is 8c. per lb., East St. Louis.

"As the probable production for the month of July will be about 48,000 tons of pig lead, this tonnage represents about one-sixth of the total production for that month. If every producer agrees to furnish his share of this sale, it means that each producer will sell one-sixth of his July production on the basis of 8c. per lb.

"Are you willing to participate in this sale? If so, please advise the chairman of the committee on lead promptly. If you own a smelter you will receive shipping instructions from the committee for the amount of your production, which you agree to furnish.

"If you do not own a smelter may we ask that you instruct the smelter which smelts your ores to furnish one-sixth of the lead content of the ore which it accepts from you in July in this government order and notify them that you will accept in settlement for that amount of lead in your ore the price that the government is paying for this lead.

"If you give such notice to your smelter please inform the committee so that it can make plans accordingly and can see to it that your smelter is required to furnish that amount of lead to the government at the 8c. price."

Zinc—During the early part of the week this market continued dull, but was a trifle weaker. Toward the close some sellers made up their minds to make things move, and on June 27 some round lots were placed at 9c. early in the day, and subsequently spelter was freely offered at 8⅞c. High grade, intermediate and brass special were unchanged in price.

The New Jersey Zinc Co. is erecting a sheet zinc rolling mill at Palmerton, Penn., and expects to have it in operation within a short time.

Zinc Sheets—Price of zinc sheets has not been changed. Market is still at $19 per 100 lb. f.o.b. Peru, Ill., less 8% discount.

Other Metals

Antimony—This market continued dull, but was a little weaker in tone. We quote spot at 19c. July shipments for China, 15½c., c.i.f., New York, duty unpaid.

Aluminum—The aluminum market continues quiet and without any new features of special interest. Quotations continue at about the same level. 59@61c. per lb. for No. 1 ingots at New York.

Bismuth—Quoted at $3@3.50 per lb.

Cadmium—Quoted at $1.50@1.75 per lb.

Cobalt—Quoted at $1.70 per lb.

Nickel—The market remains steady at 50@55c. per lb. for nickel. Electrolytic commands an additional 5c. per lb.

Quicksilver—Market still dull, quotations being at $80, New York. San Francisco reports by telegraph, $81, active.

Gold, Silver and Platinum

Gold—Gold to the amount of $34,341,000 has arrived from Canada for account of J. P. Morgan & Co., and has been deposited in the Federal Reserve Bank, New York.

Silver—The silver market has ruled steady and firm in London during past week. The bulk of the shipments is going to the Orient via San Francisco owing to difference in freight and insurance cost on account of War conditions.

Mexican dollars at New York, June 20, 58⅞c.; 21, 60½c.; 22, 61⅝c.; 23, 61⅝c.; 25, 61⅝c.; 26, 61½c.

Platinum—Unchanged at $105.

Our Petrograd correspondent reports, under date of Apr. 23, 1917, that the demand for the metal is good, but the supply small. From Ekaterinburg it is reported that the cost of production has sharply increased, owing to the increase in the wages of miners, due to the revolution. Transactions in small quantities of platinum, exempt from requisition, are made at a price of $98@107.80 per ounce of crude metal.

Palladium—Unchanged at $108@110.

Zinc and Lead Ore Markets

ZINC AND LEAD MARKETS

Platteville, Wis., June 23—Blende, basis 60% Zn, $80 for premium ore down to $73 for medium grade. Lead ore, basis 80% Pb, $132 per ton. Shipments reported for the week are 2977 tons of zinc ore, 39 tons of lead ore, and 915 tons of sulphur ore. For the year to date the figures are: 66,537 tons of zinc ore, 2847 tons of lead ore, and 13,076 tons of lead ore. Shipped during the week to separating plants, 4380 tons of zinc ore.

Joplin, Mo., June 23—Blende per ton, high, $81.80; basis 60% Zn, premium ore $80, medium to low $76@70; calamine per ton, basis 40% Zn, $45@40; average selling price, all grades of zinc, $69.34 per ton. Lead, high, $133.15; basis 80% Pb $130; average selling price, all grades of lead, $129.95 per ton.

Shipments, the week; blende 8556 tons, calamine 1931 tons, lead 1925 tons. Value, all ores the week, $956,860.

Lack of cars reduced the shipment several hundred tons below the sales. Buying was fully as strong as any recent week for blende, while the 2600 tons reserve calamine at Granby was all absorbed and the bulk of it shipped. This large shipment of calamine lowered the average price of all ores $3.24 per ton below the previous week. Several additional mines in the sheet ground area were closed permanently tonight.

Other Ores

Iron Ore—Prices delivered lower Lake ports, are for old range bessemer, $5.95; Mesabi bessemer, $5.70; old range nonbessemer, $5.20, and Mesabi nonbessemer, $5.05.

Molybdenum Ore—Small sales were made at $2.10 per lb. of molybdenum sulphide in concentrates assaying 90%.

Manganese Ore—Unchanged at $1 per unit for high grade metallurgical ore.

Pyrites—Spanish lump quoted at 15@15½c. per unit on basis of 10s. freight, buyer to pay war risk and excess freight. Recent order delivered at Jacksonville, Fla., for 15½c. on above basis. Ocean rates continue to mount; a recent charter was arranged at 42s. 6d., to an Atlantic port—about 5s. higher than previous rate.

Tungsten Ore—A large business was done, some contracts being closed that covered the remainder of 1917. For wolframite $21@22 was paid repeatedly. Scheelite was much in demand, and premiums of $2@3 over the price of wolframite were paid. We quote the market at $21@22 for wolframite.

Other Minerals

Barytes—Bleached white grade advanced to $27 per ton; off-color grade at $14 per net ton.

Fluorspar—Increased demand has resulted in advanced prices. 98% acid grade, 2½c. and 95% grade, 2¼c. per lb.[1]

Magnesite—Prices practically unchanged. Calcined, 85% oxide, at 3¼c. for pea size or 6¼c. for 200-mesh product. Dead burnt is 3c. and raw carbonate 1¼c. for futures, 2¼c. per lb. for spot.[1]

Monazite Sand—Price advanced to $65 per unit of ThO_2 per net ton.[1]

Rutile—Crude material, 95% titanium oxide, advanced nominally to 10c. per lb. though there is no stock in this country.[1]

Zirkite—The 80% oxide firm at 6c. with additional charges of 1½ and 2½c. for 50-mesh and 200-mesh grinding. Prices per pound. The 99% oxide quoted at $2.50.[1]

Iron Trade Review

NEW YORK—June 27

The agitation of Government control of prices for iron and steel products and for coal and coke, says "Iron Age," has added a new and serious element of uncertainty to the situation, and the perplexities of buyers have increased as prices have made further advances.

PITTSBURGH—June 26

The steel market is entirely undefined and is practically in a state of chaos. It is possible to buy finished-steel products by shopping around, but only at very fancy prices and there are constant advances. Prices quoted are already so far above the prices at which regular customers are now receiving shipments on old contracts that the average consumer could not possibly afford to pay them. For weeks past there have been no regular quotations made on contracts for shipment at mill convenience. The average buyer would not care to contract for such deliveries, which would be chiefly in 1918, but it is probable that some of the mills are taking care of some of their regular customers, for additional tonnages, at special prices.

Government orders are being placed right along, but only for relatively limited tonnages by comparison with the total estimated requirements. Bids are being solicited on a great deal of material and it is thought that there is much duplication in these inquiries. Contracts for ships are being placed right along, without the price of the steel being settled. The price will be between the 2.50c. suggested by Chairman Denman for bars, plates and shapes, and the 4.25c. for plates and 3.75c. for bars and shapes suggested by General Goethals.

Labor has grown scarcer and there is talk of another wage advance, there having been three last year and one this year, but some mill managers assert another advance would result in the men working still less regularly.

The market for heavy melting steel scrap has experienced a break, there being much freer offerings this week by the small dealers, and at lower prices, $40 to $42.50.

Pig Iron—The market continues to advance, but much less sharply, and the buying has narrowed down, many consumers being indisposed to take hold for next year, while they are covered for this year. Basic sold in a round lot for first quarter at $54, valley, $4 above the former established level. Bessemer has brought $57.50 for 500 tons for instant shipment and $56 for deferred delivery, against $55 formerly held as the market. Foundry iron has advanced $3 to $53 minimum, with small prompt lots going at $55. We quote: Bessemer, $56@57.50; basic, $54@55; foundry and malleable, $53@55, f.o.b. valley furnaces, 95c. higher delivered Pittsburgh.

Coke

Connellsville—Car supplies are poor, with no result, at least thus far, from the Commission on Car Service order of June 19 that 20% more cars be furnished the region. Spot is up nearly $2 a ton, to $13@13.50 for furnace and $14@14.50 for foundry, per net ton at ovens.

[1]Quotations supplied by Foote Mineral Co., Philadelphia.

STOCK QUOTATIONS

N. Y. EXCH.†	June 26
Alaska Gold M.	5⅛
Alaska Juneau	4⅜
Am.Sm.& Ref.,com.	107⅞
Am. Sm. & Ref., pf.	113⅛
Am. Sm. Sec., pf., A	98
Am. Sm. Sec., pf. B	90
Am. Zinc	31
Am. Zinc, pf.	62
Anaconda	82⅛
Batopilas Min	1
Bethlehem Steel	141½
Bethlehem Steel, pf.	120
Butte & Superior	41⅛
Cerro de Pasco	36⅛
Chile Cop.	21⅛
Chino	56⅛
Colo.Fuel & Iron	52⅛
Crucible Steel	86⅛
Dome Mines	10⅛
Federal M. & S.	17
Federal M. & S., pf.	44⅛
Great Nor., ore ctf.	31⅛
Greene Cananea	41
Gulf States Steel	125
Homestake	105
Inspiration Con.	63⅛
International Nickel	39⅛
Kennecott	45
Lackawanna Steel	96⅛
Miami Copper	41⅛
Nat'l Lead, com.	57
National Lead, pf.	108
Nev. Consol.	23⅛
Ontario Min	5⅛
Quicksilver	1⅛
Quicksilver, pf.	1⅛
Ray Con	28⅛
RepublicI.&S.,com.	92
Republic I. & S., pf.	103⅞
Sloss-Sheffield	60⅛
Tennessee C. & C.	18⅛
U. S. Steel, com	130⅛
U. S. Steel, pf.	117⅞
Utah Copper	110⅛
Va. Iron C. & C.	70

N. Y. CURB†	June 26
Big Ledge	2⅛
Butte & N. Y.	1⅛
Butte C. & Z.	11
Caledonia	.58
Calumet & Jerome	1⅛
Can. Cop. Corpn.	2 1/16
Carlisle	5
Cashboy	.08⅛
Con. Ariz. Sm.	2⅛
Con. Coppermines	5⅞
Con. Nev.-Utah	1/16
Emma Con.	1
Ferber	.63
First Nat. Cop.	2⅛
Goldfield Con.	.50
Goldfield Merger	.06
Greenmonster	1
Hecla Min.	8⅞
Howe Sound	5⅛
Jerome Verde	1 1/16
Joplin Ore & Spel.	‡.15
Kerr Lake	4⅛
Magma	42
Majestic	.40
McKinley-Dar-Sa.	.48
Mohican	.75
Mother Lode	.26⅛
N. Y. & Hond.	12
Nipissing Mines	7⅛
Ohio Cop.	1 1/16
Ray Hercules	3⅛
Rochester Mines	.52
St. Joseph Lead	18⅛
Seneca	‡ 10⅛
Standard S. L.	71⅞
Stewart	34⅛
Success	.38
Tonopah	6⅛
Tonopah Ex.	2⅛
Tribullion	.25
Troy Arizona	.28
United Cop.	.81⅛
United Verde Ext.	.38
United Zinc	4⅛
White Knob, pf.	1⅛
White Oaks	‡2
Yukon Gold	1⅛

SAN FRAN.*	June 26
Alta	.03
Andes	.10
Best & Belcher	.01
Bullion	.02
Caledonia	.11
Challenge Con.	.01
Confidence	.10
Con. Virginia	.22
Could & Curry	.01
Hale & Norcross	.03
Jacket-Cr. Pt.	.06
Mexican	.11
Occidental	.65
Ophir	.11
Overman	.04
Savage	.08
Seg Belcher	.02
Sierra Nevada	.15
Union Con.	.18
Utah Con.	.01
Belmont	4.00
Jim Butler	.76
MacNamara	.21
Midway	.09
Mont. Tonopah	.20
North Star	.09
Rescue Eula	.20
West End Con.	.64
Atlanta	.09
Booth	.08
Comb. Frac.	.04
D'field Daisy	.03
Florence	.19
Jumbo Extension	.32
Kewanas	.12
Nevada Hills	.23
Nevada Packard	.34
Round Mountain	.33
Silver Pick	.09
White Caps	1.20
Big Jim	.65
United Eastern	4.37½

BOSTON EXCH.*	June 26
Adventure	2¾
Ahmeek	98
Algomah	.60
Allouez	62
Ariz. Com., ctfs.	14½
Arnold	.30
Bonanza	.20
Butte-Balaklava	.55
Calumet & Ariz.	80½
Calumet & Hecla	535
Centennial	18
Copper Range	61½
Daly West	1
Davis-Daly	5⅛
East Butte	12⅛
Franklin	6⅛
Granby	‡83
Hancock	14
Hedley	15
Helvetia	.30
Indiana	2
Island Cr'k, com.	72
Isle Royale	32
Keweenaw	1⅛
Lake	12⅛
La Salle	3
Mason Valley	6⅛
Mass	12⅛
Mayflower	2
Michigan	2
Mohawk	94⅛
New Arcadian	2⅛
New Idria	14⅛
North Butte	16⅛
North Lake	1
Oilway	1⅛
Old Dominion	59
Osceola	91
Quincy	85⅛
St. Mary's M. L.	81
Santa Fe	1
Shannon	8⅛
Shattuck-Ariz.	27
So. Lake	3¼
So. Utah	.25
Superior	8⅛
Superior & Bost.	4⅛
Trinity	4⅛
Tuolumne	1⅛
U. S. Smelting	61⅛
U. S. Smelt'g, pf.	50⅛
Utah Apex	2
Utah Con.	15⅛
Utah Metal	4⅛
Victoria	3⅛
Winona	3⅛
Wolverine	44
Wyandot	.60

BOSTON CURB*	June 26
Alaska Mines Corp.	.75
Bingham Mines	12⅞
Boston Ely	.40
Boston & Mont.	.60
Butte & Lon'n Dev.	.15
Calaveras	3⅛
Calumet-Corbin	.01
Chief Con.	2⅛
Cortez	.20
Crown Reserve	.28
Crystal Cop.	1⅛
Eagle & Blue Bell	2⅛
Houghton Copper	.95
Intermountain	1
Iron Cap, Com.	17
Iron Cap Cop., pf.	17
Mexican Metals	.27
Mines of America	1⅞
Mojave Tungsten	.45
Nat. Zinc & Lead	.70
Nevada-Douglas	1⅛
New Baltic	1⅛
New Cornelia	19
Oneco	.50
Pacific Mines	.25
Rex Cons.	.24

SALT LAKE*	June 26
Bannack	1.00
Big Four	.56
Black Jack	.06
Cardiff	6.80
Colorado Mining	.20
Daly-Judge	‡8.50
Empire Copper	1.25
Gold Chain	.11
Grand Central	.56
Grand Gulch	.19
Iron Blossom	1.00
Lower Mammoth	.03
May Day	.07½
Moscow	.12
Prince Con.	1.10
Silver-King Coal'n.	3.10
Silver King Con.	3.72½
Sioux Con.	.11½
So. Hecla	1.05
Uncle Sam	.04
Wilbert	.19
Yankee	.10

TORONTO*	June 26
Bailey	.03
Beaver Con.	.30
Buffalo Mines	1.25
Chambers Ferland	.11
Coniagas	4.00
La Rose	.40
Peterson Lake	.07½
Right of Way	.05
T. & Hudson Bay	‡38.00
Temiskaming	.39
Wettlaufer-Lor.	.05½
Dome Exten.	.15
Dome Lake	.14
Foley O'Brien	.67
Hollinger	3.50
Jupiter	‡.28
McIntyre	1.45
Newray	.60
Porcu. Crown	.49
Schumacher	.40
Vipond	.25
West Dome	.18

STOCK QUOTATIONS—Continued

COLO. SPRINGS	June 26
Cresson Con.	5.12½
Doctor Jack Pot	.05
Elkton Con.	.07
El Paso	.30
Gold Sovereign	.03½
Golden Cycle	2.20
Granite	.48
Isabella	.09½
Mary McKinney	.18
Portland	1.45
United Gold M.	.23
Vindicator	.78

LONDON	June 13		
Alaska Mexican	£0	10s	0d
Alaska Tre'dwell	1	5	0
Burma Corp.	4	3	9
Cam & Motor	0	8	9
Camp Bird	0	6	6
El Oro	0	9	9
Esperanza	0	10	9
Mexican Mines	4	2	6
Nechi, pfd.	0	11	9
Oroville	0	16	3
Santa Ger t'dis.	0	10	0
Tomboy	0	19	3

* Bid prices. † Closing prices. ‡ Last Quotations.

MONTLY AVERAGE PRICES OF METALS

Silver	New York			London		
	1915	1916	1917	1915	1916	1917
January	48.855	56.775	75.630	22.731	26.960	36.682
February	48.477	56.755	77.585	22.753	26.975	37.742
March	50.241	57.935	73.861	23.708	27.597	36.410
April	50.250	64.415	73.875	23.709	30.662	36.963
May	49.915	74.269	74.745	23.570	35.477	37.940
June	49.034	65.024		23.267	31.060	
July	47.519	62.940		22.597	30.000	
August	47.163	66.083		22.780	31.498	
September	48.680	68.515		23.591	32.584	
October	49.385	67.855		23.925	32.361	
November	51.714	71.604		25.094	34.192	
December	54.971	75.765		26.373	36.410	
Year	49.684	65.661		23.675	31.315	

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0 925 fine

Copper	New York		London			
	Electrolytic		Standard		Electrolytic	
	1916	1917	1916	1917	1916	1917
Jan	24.008	28.673	88.083	131.921	116.167	142.895
Feb.	26.440	31.750	102.667	137.895	133.167	148.100
Mar.	26.310	31.481	107.714	136.750	136.000	151.000
April	27.895	27.935	124.319	133.842	137.389	147.158
May	28.625	28.788	135.457	130.000	152.522	142.000
June	26.601		112.432		137.455	
July	23.865		95.119		125.506	
Aug.	26.120		110.283		126.304	
Sept.	26.855		113.905		134.071	
Oct	27.193		122.750		142.523	
Nov	30.625		134.659		155.432	
Dec.	31.890		145.316		162.842	
Year	27.202		116.059		138.281	

Tin	New York		London	
	1916	1917	1916	1917
January	41.825	44.175	175.548	185.813
February	42.717	51.420	181.107	198.974
March	50.741	54.388	193.609	207.443
April	51.230	55.910	199.736	220.171
May	49.125	63.173	196.511	245.114
June	42.231		179.466	
July	38.510		168.357	
August	38.565		169.870	
September	38.830		171.345	
October	41.241		179.307	
November	44.109		186.932	
December	42.635		183.368	
Av year	43.480		182.096	

Lead	New York		St Louis		London	
	1916	1917	1916	1917	1916	1917
January	5.921	7.626	5.826	7.530	31.167	30.500
February	6.246	8.636	6.164	8.595	31.988	30.500
March	7.136	9.199	7.375	9.120	34.440	30.500
April	7.630	9.288	7.655	9.158	34.368	30.500
May	7.463	10.207	7.332	10.202	32.967	30.500
June	6.936		6.749		31.011	
July	6.352		6.185		28.137	
August	6.244		6.088		29.734	
September	6.810		6.699		30.786	
October	7.000		6.898		30.716	
November	7.042		6.945		30.500	
December	7.513		7.405		30.500	
Year	6.853		6.777		31.359	

Spelter	New York		St Louis		London	
	1916	1917	1916	1917	1916	1917
Jan	16.915	9.619	16.745	9.449	89.810	48.329
Feb.	18.420	10.045	18.260	9.875	97.762	47.000
Mar	16.846	10.300	16.676	10.130	95.048	47.000
April	16.695	9.459	16.525	9.289	99.056	54.632
May	14.276	9.362	14.106	9.192	94.217	54.000
June	11.752		11.582		68.591	
July	8.925		8.755		50.750	
Aug.	8.730		8.560		51.587	
Sept	8.990		8.820		52.095	
Oct	9.829		9.659		54.159	
Nov.	11.592		11.422		56.023	
Dec.	10.665		10.495		55.842	
Year	12.804		12.634		72.071	

New York and St. Louis quotations, cents per pound, London, pounds sterling per long ton. ¦ Not reported.

Pig Iron, Pitts.	Bessemer‡		Basic‡		No. 2 Foundry	
	1916	1917	1916	1917	1916	1917
January	$21.60	$35.95	$18.78	$30.95	$19.70	$30.95
February	21.16	36.37	18.93	30.95	19.51	30.95
March	21.81	37.37	19.20	33.49	19.45	35.91
April	21.65	42.23	18.95	38.90	19.45	40.06
May	21.78	46.94	19.11	42.84	19.58	43.60
June	21.95		18.95		19.34	
July	21.95		18.95		19.20	
August	21.95		18.95		19.22	
September	22.88		19.58		19.53	
October	24.61		21.26		21.51	
November	30.07		28.18		26.55	
December	35.16		30.95		30.79	
Year	$23.88		$20.98		$21.15	

‡ As reported by W. P. Snyder & Co.

Volume 103 Number 26

Engineering and Mining Journal

WALTER RENTON INGALLS, *Editor*

June 30, 1917

*ILLUSTRATED ARTICLE

***Mining in Southern Peru** 1133
By Francis Church Lincoln.
Description of the Mining Region in southern Peru bordering upon Lake Titicaca, covering the operating mines and geology of the district.
Engineering and Mining Journal, June 30, 1917.

***The Amorphous Silica of Southern Illinois** 1136
By E. A. Holbrook.
Novaculite, Mined for Paving material, soft bands mined and ground for use in the arts and industries. Methods of mining, preparation for market and grades produced.
Engineering and Mining Journal, June 30, 1917.

***Bunker Hill Lead Smeltery Nearly Ready** 1139
Special Correspondence.
With the Blowing In of the Bunker Hill & Sullivan lead smeltery, the Cœur d'Alene district in Idaho will for the first time in its history reduce to metal an important part of its product. In handling of materials, the plant follows copper-smelting practice more closely than the old lead practice with the result of a compact plant, susceptable of ready enlargement.
Engineering and Mining Journal, June 30, 1917.

Phosphoric Acid Determination in Phosphate Rock 1140
By C. Carleton Semple.
Description of the Analytical Methods applied to phosphate rock, which is mined as a fertilizer constituent.
Engineering and Mining Journal, June 30, 1917.

***An Ore-Testing Laboratory** 1142
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The Construction of an ion-testing laboratory, designed to work out a feasible milling process for a particular ore, is described. The equipment and its uses are outlined.
Engineering and Mining Journal, June 30, 1917.

Platinum Deposits of the World 1145
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Engineering and Mining Journal, June 30, 1917.

Raw Materials for Sulphuric Acid 1146
Washington Correspondence.
A Note of the Pyrites supply in the United States and the quantity imported.
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***Equivalent Cost of Coal and Oil as Fuel** 1147
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The Determination of Silica 1155
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Engineering and Mining Journal, June 30, 1917.

Credits in South America 1157
By Mark R. Lamb.
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Engineering and Mining Journal, June 30, 1917.

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Butte Correspondence.
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CHRONOLOGY OF MINING—Published in the second issue each month.
CURRENT PRICES OF MINING SUPPLIES—Published in the second issue each month.
NEW PUBLICATIONS—Published in the third issue each month.

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CIRCULATION OF THIS ISSUE, 11,500 COPIES

Moments With the Ad Editor

FOR every positive there is a negative. There is a cure for every evil, even the submarine. While Germany is boasting that no cure can be found for her undersea warfare, someone will discover a method that will make every sailor feel that he is going to his death when he ships aboard one. What is going to stop this machine war? Machines and more machines. What put the German army on the defensive? Machinery. What will bring about another "strategic retreat" but more machines? The world's most destructive guns must be met by guns of greater range and destructiveness.

American machine tools, lathes, presses by the thousands will operate 24 hours a day in order to let the war machines fight at long distance and save the lives which would be sacrificed in close fighting.

American invention has made many of the terrible destructive machines of this war possible. The torpedo, the submarine, the aeroplane, the machine gun, trench warfare, tanks, tractors, were all American inventions.

A TERRIBLE cry went up from Germany a short time ago because an American firm told in an advertisement how it was possible for Americans to make ammunition by the use of the same machinery which they were using to make shells against the Allies. In a large sense this cry was hypocritical because the Krupp Works at Essen were using more of these same American machine tools than any other works in the world.

To a large extent this war is an industrial mobilization. In a most important sense it is a war of smokestacks. It is long distance fighting in which the man at the gun does not see the enemy. The eyes of the army signal from aeroplanes thousands of feet in the air. The submarine stalks its prey a thousand yards distant in comparative safety. Sea battles are fought when ships are miles apart. The real work is done by the factories turning out guns and shells. The chemist, the maker of farming machinery, the railroad engineer, the inventor, all play their important parts thousands of miles from the front.

Tractors, ambulances, ships, machine guns, torpedoes, mines, submarines, and submarine destroyers, nets, cannon, shells, engines, freight cars, rails and railroad supplies, and thousands of other things are everyday necessities of war.

THE only counter offensive in a machine war is war machinery.

It is America's part to produce these necessities in undreamed of quantities and at the lowest possible cost.

German efficiency has been widely advertised, like the Hindenburg line, and it has many features about it that war will force us to adopt to our benefit; but compared to what an aroused and thoroughly fighting American can and will do in producing machinery to destroy, Germany's production will be as a rain puddle to the ocean. This war will be of lasting benefit to us as a nation if it points the way to greater efficiency in the arts of peace.

It takes but an instant to realize that, scarcely without exception, the necessities of modern war could not be produced were it not for the metal mines. They are in the last analysis, the bulwark. It is but a short step to the obvious conclusion that the production of metals must and will be increased. Iron, copper, nickel, chromium, manganese—many others—must all do their part.

In this "call to the colors" the metal mining industry has a big responsibility and as usual is measuring up to it.

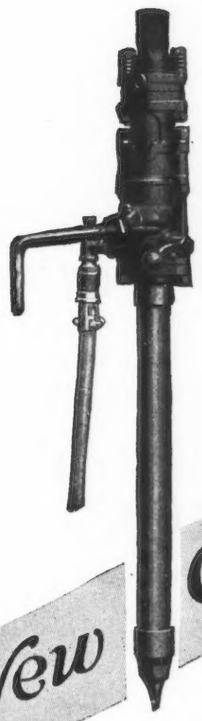
As for the Journal—it will "do its bit," and more.

To the Men From Missouri Valley

They say you are cautious, careful, discriminating.

Accept our congratulations for being so! You want to be shown—but you are there with the goods when you are convinced.

All we ask is the chance to show you something about stopers. We can convince you that the



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is the fastest rock cutter you ever put into your mine. Not only that. We can show you it is the most economical in air consumption — the most economical in upkeep.

The way it is done is through a demonstration in your mine, under everyday working conditions. We ask you to believe nothing that you don't see with your own eyes. Let your own senses pass judgment—not ours.

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Salt Lake City, Utah—811 Walker Bank Building.
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Los Angeles—Harron, Rickard & McCone.

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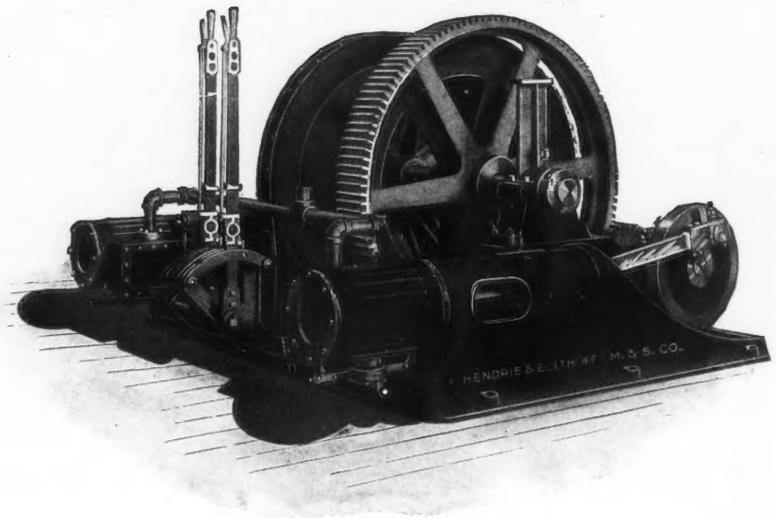

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Atolia Mining Co., Atolia, Calif.
Smuggler Union Mining Co., Telluride, Col.
Granby Mining & Smelting Co., Joplin, Mo.
Field Mining & Milling Co., Seales Mound, Ill.
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Bingham-New Haven Copper & Gold Mining Co., Bingham, Utah
Hollinger Gold Mines, Ltd., Timmins, Ont., Can.
Dominion Reduction Co., Cobalt, Ont., Can.
Prince Consolidated Min. & Smelting Co., Panaca, Nev.
McKinley-Darragh Savage Mines Co., Cobalt, Ont., Can.
Irtysh Corporation-Ridder Mining Co., Ridderiski, Siberia
Russo-Asiatic Corporation, Ltd., Nerchinsk, Siberia
W. L. Reeder, Johannesburg, S. Africa
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St. Anthony Mines, Lovelock, Nev.

The New Deister Simplex Rougher and Finisher

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Recent re-orders totaling 381 Deister Simplex Sand Tables and 172 Deister Simplex Slime Tables tell a story of satisfaction complete. Just as the proof of the pudding is in the eating so is the proof of classifying machinery in its performance—in its ability to not only show superiority in comparative tests but to maintain that showing in prolonged service. That's where Deister Simplex equipment excels—in standing the racket, in large capacity, in economy of water, in automatic control of the line of separation, in cleaner concentrate and lower tailing.

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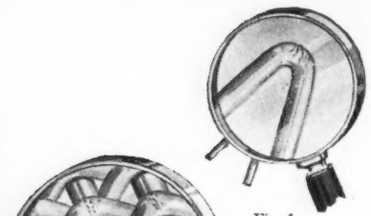

Fig. 1

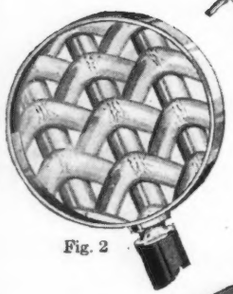

Fig. 2

Fig. 3

THE fullest appreciation of the lasting quality of "Perfect" Double Crimp Wire Cloth can be gained by a comparison of the effects on the wires in single crimp and double crimp construction.

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Now you know what we mean when we say "Perfect Wire Cloth wears long and evenly."

Write for our book on screens and screening. It's yours for the asking.

The Ludlow-Saylor Wire Co.

General Office and Factory, St. Louis, Mo.

Branch Offices: 20 East Jackson Blvd., Chicago.
Mills Building, El Paso, Texas.
Felt Building, Salt Lake City, Utah.

One of a Series of Six Advertisements Throwing a Strong Light on the Structural and Mechanical Advantages of "Perfect" Screens for Mining and Milling Use.

22½ Tons an Hour from the 1000-ft. Level

In other words, you can pull out of your mine shaft in one 8-hour shift 180 tons of ore from the 1000-ft. level with this small hoist driven by an electric motor of only 50 h.p.

One of our electric hoists was installed in a mine at Parral, Mexico, in 1901 and is still in operation. This shows how well-built

DEWCO Electric Hoists

are. DEWCO Electric Hoists are built sectional for transportation and installation in underground workings. They have heavy band clutches, self-locking when closed, with powerful grip for maximum service. They are equipped with heavy, semi-self-tightening brakes.

All parts interchangeable. Particular care is given to material and workmanship of bearings.

Important moving parts are open to the eye and inspection—not hidden.

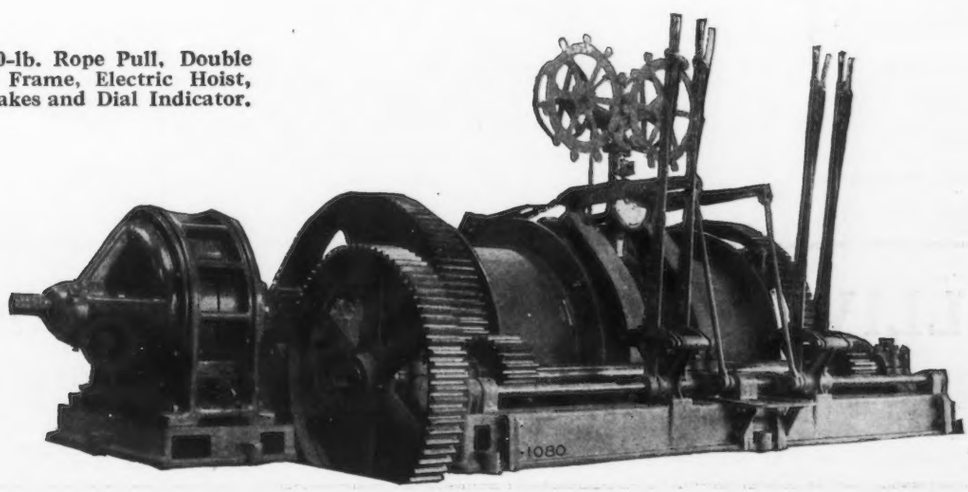
We build a complete line of electric hoists. Bulletin No. 1066 describes the one shown here, which has a rope pull of 5000 lb. Bulletins of smaller or larger sizes sent also on request.

The Denver Engineering Works Co.

3100 Blake Street *Also Makers of* **Denver, Colorado**

Richards Pulsator Jigs	Ore Crushers	Richards Pulsator Placer Jigs	Stamp Mills
Ovoca Classifiers	Automatic Samplers	Crushing Rolls	Revolving Grizzles
Electric Hoists	Richards Pulsator Classifiers	Mine Cages	Sample Grinders
Dewco Ball Mills			Dewco Tube Mills

DEWCO 5000-lb. Rope Pull, Double Drum, Low Frame, Electric Hoist, with Post Brakes and Dial Indicator.



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BLUEFIELDS
BROKEN HILL
BUTTE
CANANEA
CERRO DE PASCO
CHIHUAHUA
COBALT
DEADWOOD
DUCKTOWN
EKATERINBURG
FLAT RIVER
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STA. EULALIA
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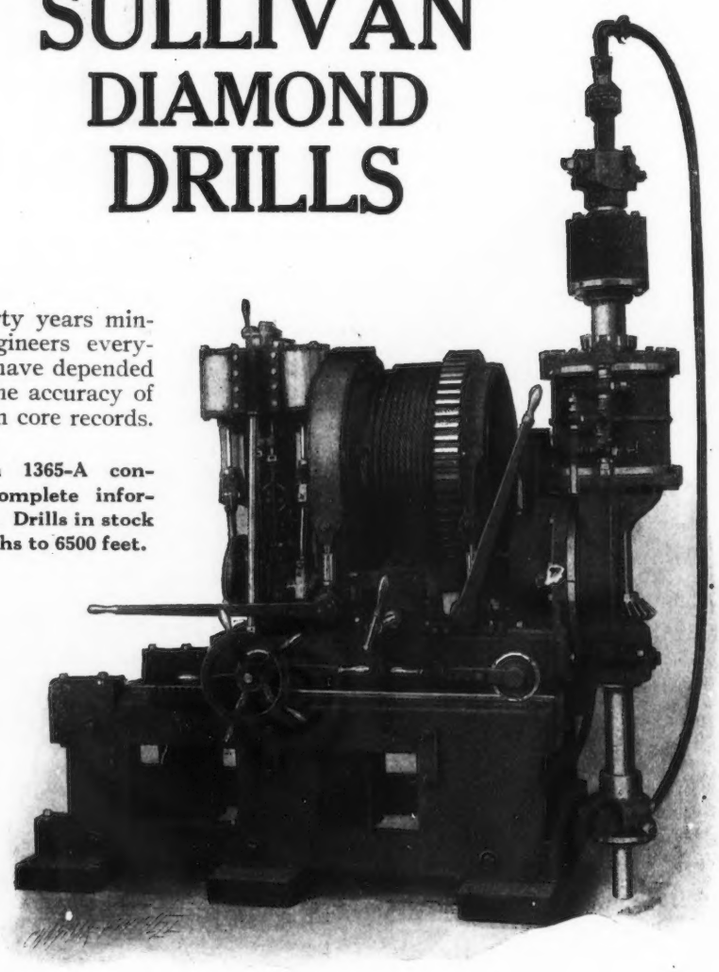
WONTHAGGI

Call the Roll

of the World's Mining Camps—

Hundreds have become famous, other hundreds have maintained their profit-earning capacity, through the findings made by

SULLIVAN DIAMOND DRILLS



For forty years mining engineers everywhere have depended upon the accuracy of Sullivan core records.

Bulletin 1365-A contains complete information. Drills in stock for depths to 6500 feet.

SULLIVAN MACHINERY COMPANY

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The Wedge Mechanical Furnace

(Patented)

All Roasts Are Not Alike

Different ores require different treatment to secure best results.

Hence the necessity for roasters built to give roasting conditions desired.

Often a slight modification in roaster detail will secure profitable results.

Write us fully, stating analysis of ore, concentrates, mixture or material you desire to roast, characteristics and physical condition of same, number of tons to be treated per twenty-four hours, and results desired in the calcine.

Wedge Mechanical Furnace Company

Greenwich Point, Philadelphia

"Perfect"

Double Crimp Wire Cloth —Why it is Best

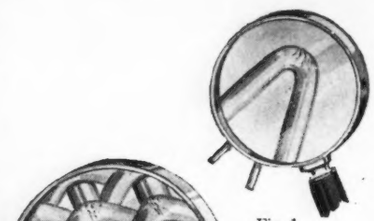

Fig. 1

Fig. 2

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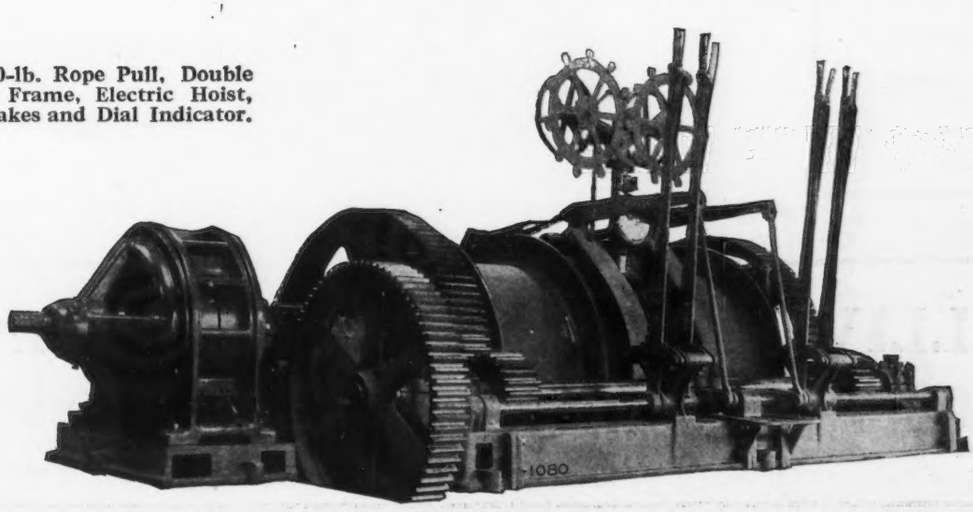

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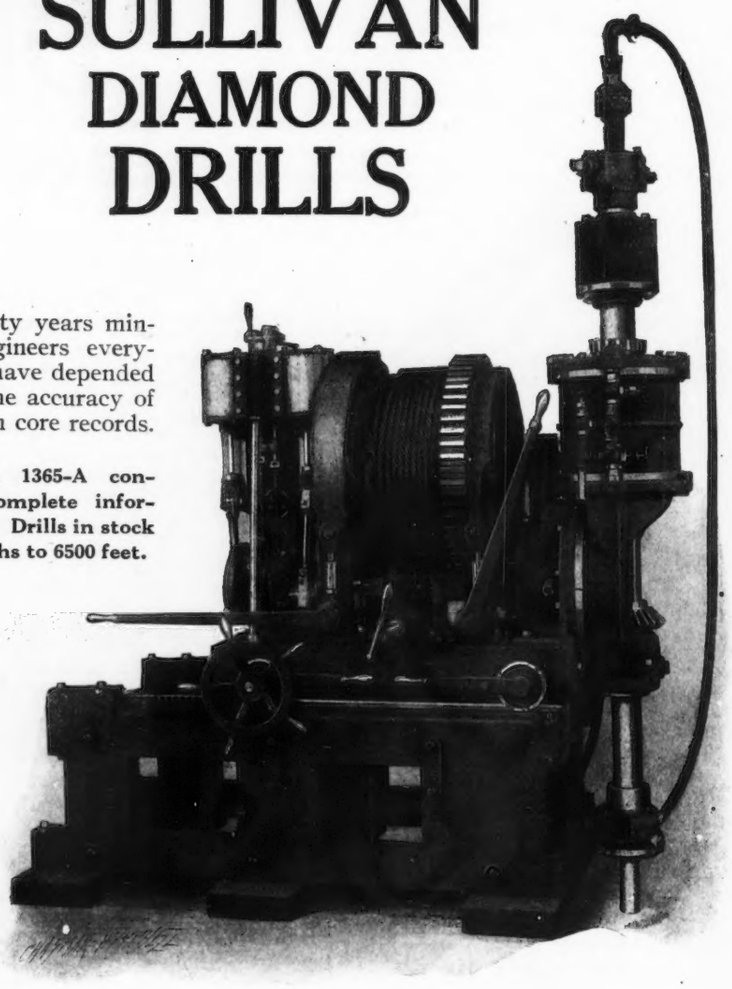

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Wedge Mechanical Furnace Company

Greenwich Point, Philadelphia

MASSCO

HEADQUARTERS FOR MINE-MILL AND SMELTER EQUIPMENT

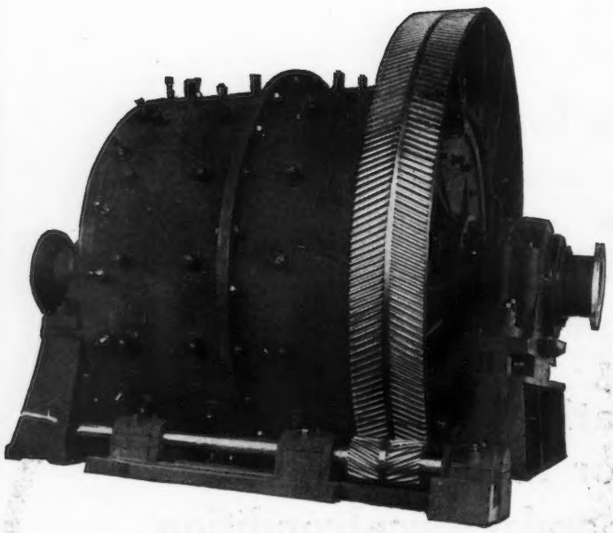
Lowest Cost per Ton

The per ton unit is the thing that wins for

MARCY BALL MILL

CRUSHING "ONE EASY STEP"

A MASSCO PRODUCT



We cite the installation of our mill in large mining properties simply for the sake of illustration as to its *proved* efficiency where *results*, and results only, win recognition. In such places things are done and changes made only *after* experimentation has proved the correctness of the step.

Small mines, therefore, can approach the question of adopting the Marcy with that full confidence which comes from a realization that the kings of the industry have stamped it with their unqualified O. K.

In the adoption of large numbers of Marcy Mills because of the performance of a trial installation you can read the record of what we have accomplished for the mining industry in developing this mill to a high point of efficiency and economy.

Removes Fines and Slimes as Fast as Produced

It takes a coarse feed direct from the crushers and delivers a product of the required degree of fineness for treatment, when operated in conjunction with screens and classifiers.

The liberal discharge area in the welded chrome steel grate, absence of regrinding, little attention required, minimum floor space and small power consumption are other reasons for Marcy superiority.

Daily Capacity 25 to 1000 Tons of Coarse Feed

Ask for booklets "One Easy Step" and "Purchasing Successfully."

THE MINE AND SMELTER SUPPLY COMPANY

A SERVICE STATION WITHIN REACH OF YOU

DENVER · SALT LAKE CITY · EL PASO

NEW YORK OFFICE - 42 BROADWAY

MASSCO PRODUCTS

•WILFLEY TABLE• MARCY MILL• ASSAY AND LABORATORY EQUIPMENT AND SUPPLIES• ELECTRICAL APPARATUS • GENERAL MINING MACHINERY• MILL EQUIPMENT

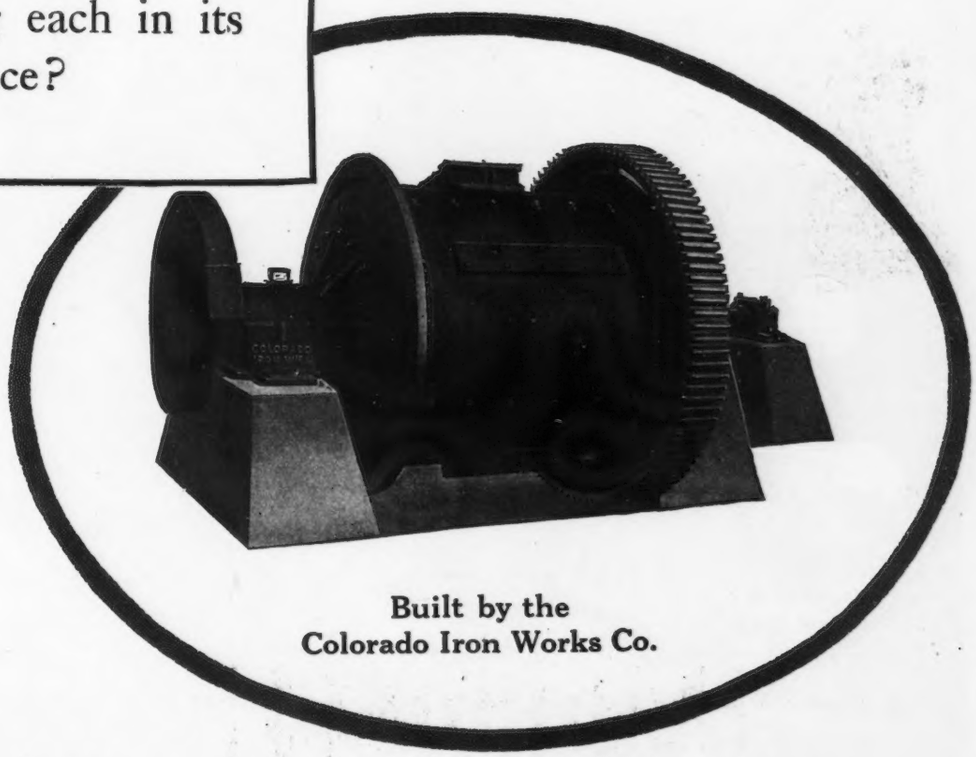
Has the pendulum swung too far?

Is there a tendency to overdo the ball mill, to push aside all other crushing machinery, instead of more profitably employing each in its proper place?

THIS question is answered in the new Colorado Grinding Machinery Bulletin from a wide experience in building and installing *all* types of crushing machinery—tube mills, grinding pans, crushers, stamps, and rolls as well as ball mills. It is a question worth consideration. The new bulletin also fully describes

The Colorado Convertible Discharge Ball Mill

This mill is built in all sizes and has highly distinctive points of merit. From a usual central discharge for fine crushing, it can easily be converted into an annular discharge through a grating for coarser crushing. It is widely used. It stands up.



Built by the
Colorado Iron Works Co.

Write for a copy of "Colorado Grinding Machinery." You will find it of assistance in selecting the correct crushing unit.

COLORADO IRON WORKS COMPANY

Ore Milling Machinery and Smelting Equipments Since 1860

NEW YORK OFFICE
309 BROADWAY

DENVER, COLORADO

"Did you say Gears?"

asks Phillie Gear

"If I heard you correctly, you see I have not wasted a moment in jumping to your assistance.

"Just look this stock over, remembering that it is only a suggestion of the gears we carry—ready for any emergency.

"Remember, too, that we have the ability and equipment to make any gear to order not included in our ample stock."

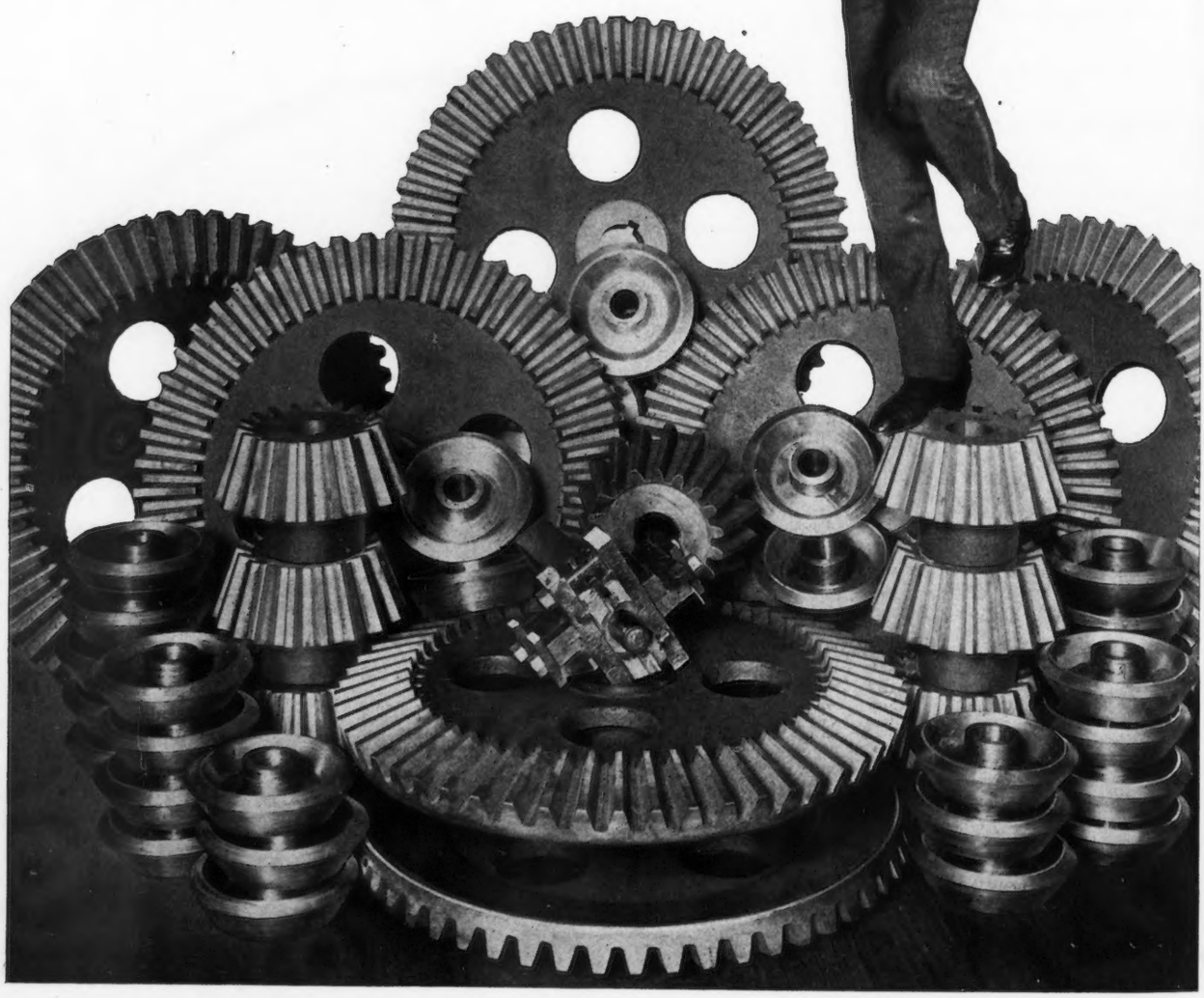
So you see Phillie Gear is ready to supply any gear used in the mining field—

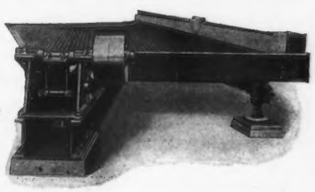
And with a speed you would hardly imagine possible.

Naturally, he dotes on emergency orders. Try him on your next one.

Catalog?

Philadelphia GEAR Works
Vine and 12th Streets, Philadelphia, Pa.





INVESTIGATE THE
DEISTER-OVERSTROM TABLE
FOR CAPACITY AND EFFICIENCY

THE DEISTER CONCENTRATOR CO.
FT. WAYNE, IND.

WILL FURNISH THIS INFORMATION

CABLE ADDRESS
"RETSIED"
A. B. C. 5TH EDITION
BEDFORD-McNEIL

DRILLING SERVICE *vs* DRILL REPAIRS

Oatman Arizona, March 11, 1917.

Mr. O. A. Carlson,
Ingersoll-Rand Co.,
Los Angeles, Calif.

Dear Sir:—

The two Jackhamer drills we bought of your company have given more satisfaction than any other machines I have ever used. With these two drills we have sunk 310 ft. of shaft and run 325 ft. of cross cuts and drifts. Our repairs have amounted to less than $10.00. The last 150 ft. of drifting was done with only one machine, and without any repairs. Both machines are now as good as new.

Yours very truly,
W. C. Rannells, Supt.,
Pictured Rock Gold Mining Co.

THE

Trade Mark Registered U. S. Patent Office

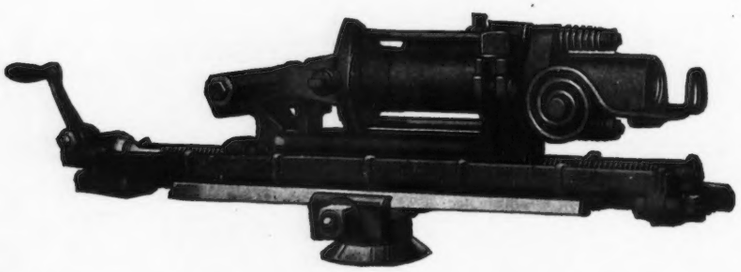
JACKHAMER

is used unmounted for shaft sinking, bench work, block holing and other down hole drilling.

For flat hole work in tunneling, drifting, etc., it can be slipped into the convenient "Jackhamer" feed shell mounting.

The "Jackhamer" is self-rotating, light weight, sturdy and economical. You will profit by its use.

Bulletin No. 4221.



INGERSOLL-RAND COMPANY

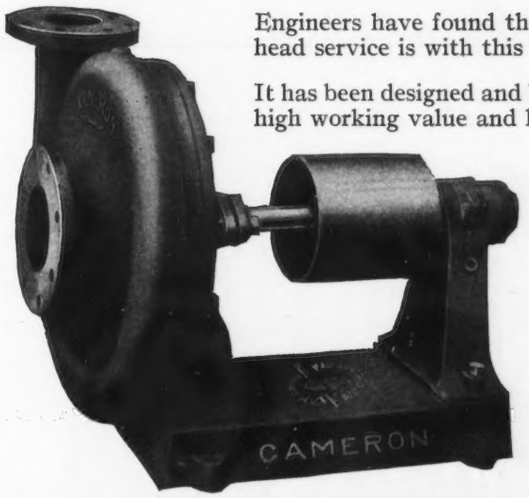
11 Broadway NEW YORK *Offices the World Over* **165 Q. Victoria St. LONDON**

For Canada, address Canadian Ingersoll-Rand Company, Montreal

AIR COMPRESSORS STOPEHAMERS LEYNER SHARPENERS

The Slogan of the Cameron—"Character: The Grandest Thing."

An Economical Low Head Pump
Cameron Centrifugal



Engineers have found that the sure way to secure pumping economy for low head service is with this "CAMERON" Centrifugal shown below.

It has been designed and built with the special aim to produce a combination of high working value and low operating cost.

Every element in this pump is given the most careful attention during manufacture. There is no skimping of small details. Every part has strength beyond the utmost load that can fall upon it.

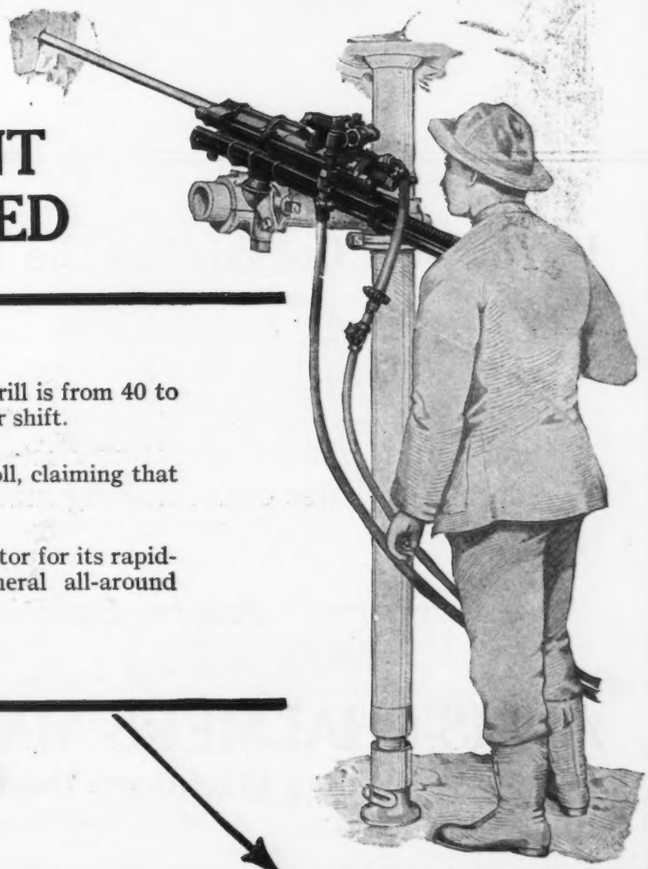
It is the **Cameron Single Suction Open Impeller** type which is especially designed for low head service. It is very simple, strong and rugged, and can be driven by belt.

Bulletin No. 152 Gives the details. Shall we send it?

A. S. CAMERON STEAM PUMP WORKS, 11 Broadway, New York

Offices the World Over

A MINE SUPERINTENDENT RECENTLY STATED



"That the upkeep of the 'Leyner-Ingersoll' Drill is from 40 to 50% less per month while doing more work per shift.

"That the miners prefer the Leyner-Ingersoll, claiming that they can do their work easier."

This drill is used by the successful mine operator for its rapidity of drilling, its low upkeep and its general all-around satisfactory performance.

INGERSOLL-RAND COMPANY

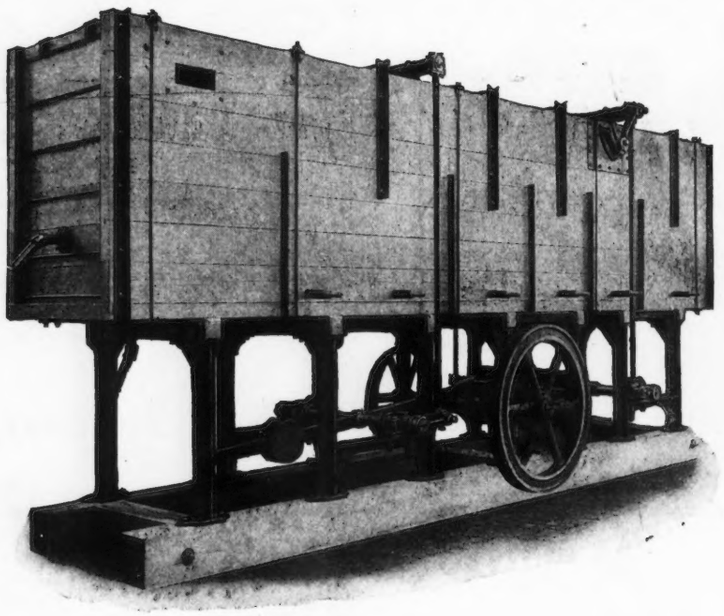
New York - London

Offices the World Over

53-LI

Ask for Bulletin No. 4120.

The Hancock Jig



If You Are Considering the Re-Treatment of Tailings

The Hancock Jig will take the tailings at ¼ to ½ inch and give clean concentrates. It will handle 100 or 800 tons per 24 hours equally well. The simplicity of construction and ease of operation tend to reduce operating costs in labor and repairs. A very successful coarse concentrating machine.

Ask for Bulletin No. 1403.

ALLIS-CHALMERS MANUFACTURING CO.

Mining Machinery Dept., Milwaukee, Wis.

Offices in All Principal Cities

Waugh "Clipper" drilling with 22 ft. steels in the ballast pit of the C. M. & St. P. Ry. Co. at Vendome, Mont.

With the WAUGH "CLIPPER" DRILLS Their Record is their Strongest Recommendation

These handy, rapid drilling little self-rotating machines are small drills of big accomplishments and great durability. They will increase your drilling speed and consequently help to increase your production.

With "Clippers" the upkeep is small and the chance of losing a hole is reduced to a minimum; for they can be cranked or worked back while rotating, without danger of breakage.

The "Clippers" can be equipped for either wet or dry drilling and used either mounted or as hand drills. When mounted they are powerful little drifting machines and will not only outdrill any other drills of their size, but are also unusually economical of power.

In the Utah Metal & Tunnel Co.'s Mine at Bingham, Utah

Walter Fitch, Jr., a contractor of Eureka, Utah, made the world's record for shaft sinking with 3 Model 55 DENVER "CLIPPER" DRILLS unmounted. He sank a 6x15-ft. shaft in hard porphyry and limestone, 261 ft. in 31 days, working 3 shifts.

THE Denver Rock Drill Manufacturing Co.

DENVER, COLO.

225 Rialto Bldg., San Francisco, Calif.
301 San Francisco Street, El Paso, Texas
508 First Avenue South, Seattle, Wash.
34 Queen Street, Melbourne, Australia

115 W. 2nd South Street, Salt Lake City, Utah
Houghton, Mich. Joplin, Mo.
CANADIAN ROCK DRILL COMPANY, LTD.
Selling Agents
42 Scott St., Toronto, Ont. 614 Baker St., Nelson, B. C.

30 Church Street, New York City
401 Title Insurance Bldg., Los Angeles, Cal.
51 W. Granite St., Butte, Mont.
Royal Chambers, Johannesburg, South Africa

E-43

The Largest Electric Hoist in the United States

Safety Always

WELLMAN-SEAVER-MORGAN

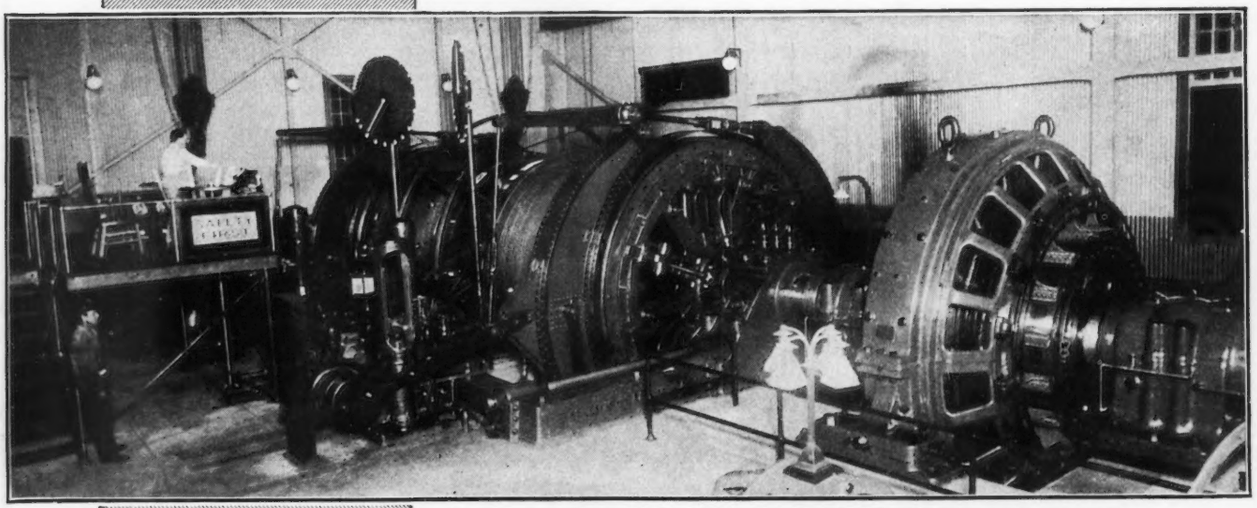
Is the Safest Hoist

It was manufactured and has been installed by Wellman-Seaver-Morgan at Granite Mountain Mine in the Butte District, Montana. The hoist is shown in operation in the picture on this page.

The hugeness of this hoist will be realized when one considers that the drums, 12 feet in diameter, have a handling capacity of seven gross tons of ore together with skip and cage and 4000 feet of 1⅝-inch rope or a gross load of 42,000 pounds when hoisting out of the balance, or of 32,000 pounds when the skips are operated in balance as is the usual practice. But in this as in all other Wellman-Seaver-Morgan Hoists safety was not overlooked.

How Safety is Inbuilt

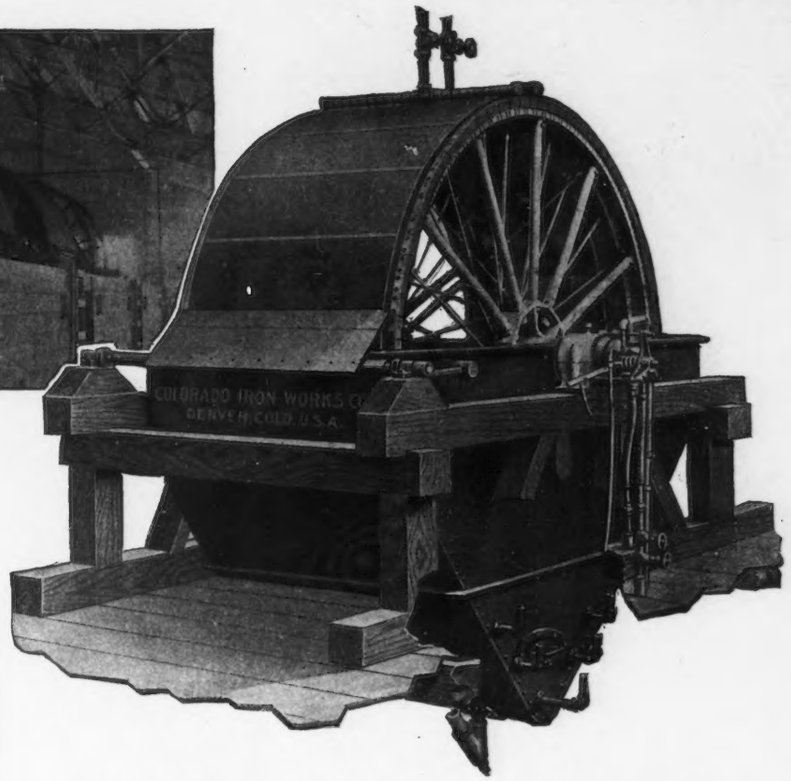
This immense machine was supplied with an auxiliary **band** brake to be used when handling men, while complete safety appliances, including electric release brakes and automatic slow-down devices are furnished to prevent skip or cage reaching the dump at too high speed, and a special controller is furnished to limit the speed when hoisting men.



Every Wellman-Seaver-Morgan is built for safety. When you need hoists be sure to consult our special Hoist Engineering Department. They have an experience that you can well make use of. Write now.

The Wellman-Seaver-Morgan Company
Cleveland, Ohio, U. S. A.

Partial view of a large Portland Filter installation



Some Users of Portland Filters

Utah Copper Co.
Cornucopia Mines Co.
Easton-Pacific Co.
Smuggler-Union Mining Co.
Barnes-King Development Co.
Ray Consolidated Copper Co.
Baker Mines Co.
Illinois Mining Co.
Chino Copper Co.
Cleaveland & Weatherhead
New Reliance Gold Mining Co.
Mogul Mining Co.
Ajuchitlan Mining Co.
Yoquivo Development Co.
Aguacate Mines
Linda-Ventura Mine
Argo-Reduction & Ore Purch. Co.
Portland Gold Mining Co.
Empire Copper Co.
Cons. Arizona Smelting Co.
Cariman Mines Co.
U. S. Smelting, Ref. & Mining Co.
Daly Judge Mining Co.
Caldo Mining Co.
Iowa-Montana Development Co.
Paragon Mining & Milling Co.
Winnemucca Mountain Mining Co.
Amalgamated Pioche M. & S. Corp.
Butte & Superior Copper Co.
Nevada Consolidated Copper Co.
American Zinc, Lead & Smelting Co.
Cons. Coppermines Co.
Ben Harrison Mines Co.
Timber Butte Milling Co.
Vindicator Cons. G. M. Co.

Filtration with the Portland Continuous Filter

has effected many real economies in many mills.

In handling flotation concentrates, it has reduced freight charges and smelter penalties, minimized labor costs, eliminated waste in shipment.

In cyaniding, it has lessened labor costs and reduced soluble losses.

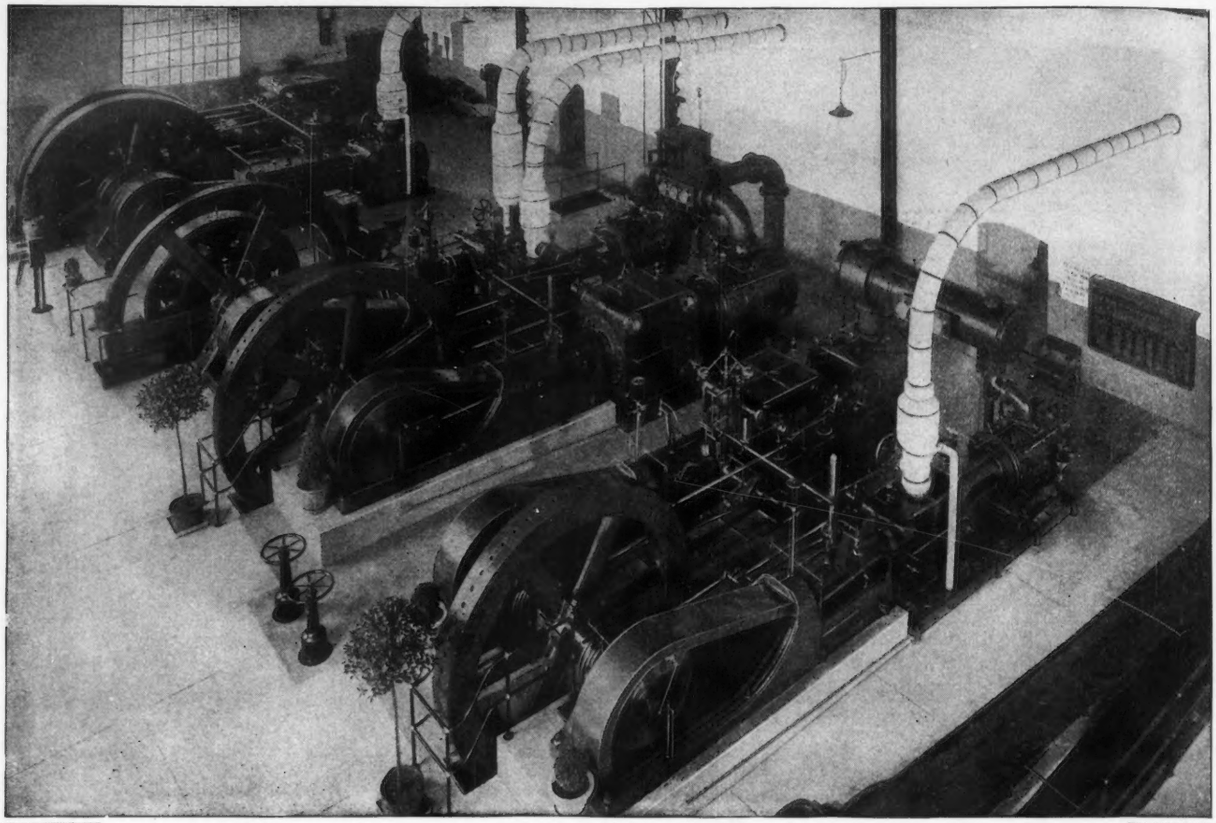
The Portland dewaters automatically and without attendance to as low as 8% moisture content; is a completely finished machine **of important exclusive features.**

We guarantee that the Portland Filter does not infringe the legal rights of the owners of any other filter or filtration patents.

Bulletin 28-B gives complete description.

Colorado Iron Works Co.

Main Office and Works: 33rd and Wynkoop St.
Down Town Office: 206 Ideal Bldg.
New York Office: 309 Broadway
Denver, Colorado, U. S. A.



A battery of Laidlaw Feather Valve Air Compressors in a large middle-western industrial plant

Recognizing the superior performance of Laidlaw Compressors, one of the largest middle-western industrial plants installed the battery shown in the engine room photograph above. These units furnish the compressed air required for pneumatic tools and for foundry use in connection with sand blasting the enamel-ware which the factory produces.

Laidlaw Compressors are built with the greatest possible care. Every pound of metal entering into construction is of the best quality, selected with special reference to the particular service for which it is intended. The machine is automatic in its action and requires little attention on the part of the engineer. Extreme simplicity and maximum durability operate to place the cost of upkeep and maintenance within the narrowest limits.

Laidlaw Air Cylinders are provided with hand holes, giving access to the water jacket for cleaning. This is an important feature not found in many of the older types of compressors. Air Cylinders not so equipped, fall off greatly in efficiency after a year or two of operation, especially in localities where water is bad, resulting in clogged water-jackets which prevents proper circulation of the water.

The Frame, Crankshaft, Connecting Rods, Crossheads, Piston Rods, and Intercoolers possess all the refinements dictated by the most advanced design and methods of construction.

While these features have met with warm approval, one vitally important characteristic, the Laidlaw Feather Valve, indisputably places the Laidlaw Compressor foremost in estimation of compressed air users.

The Laidlaw Feather Valve is the most efficient valve ever developed for air compressor service.

Absence of springs, buffer plates and cushioning devices make it the simplest valve.

Lightness and contact seating give it silent operation and perfect safety at high speeds.

Flexibility, lift area, and tightness of seating result in minimum air friction and power consumption.

The valve itself is practically indestructible. In a durability test of 40,000,000 revolutions, with a Laidlaw Feather Valve only the slightest signs of wear were visible.

If you are interested in compressors whose air valves have no outside gear, no impact, no springs to break, no plates to crystallize, no leakage—air valves that will lift your compressor above troubles and interruptions of service, get full information in our Bulletin L-533-16. **A copy will be sent on request.**

WORTHINGTON PUMP AND MACHINERY CORPORATION

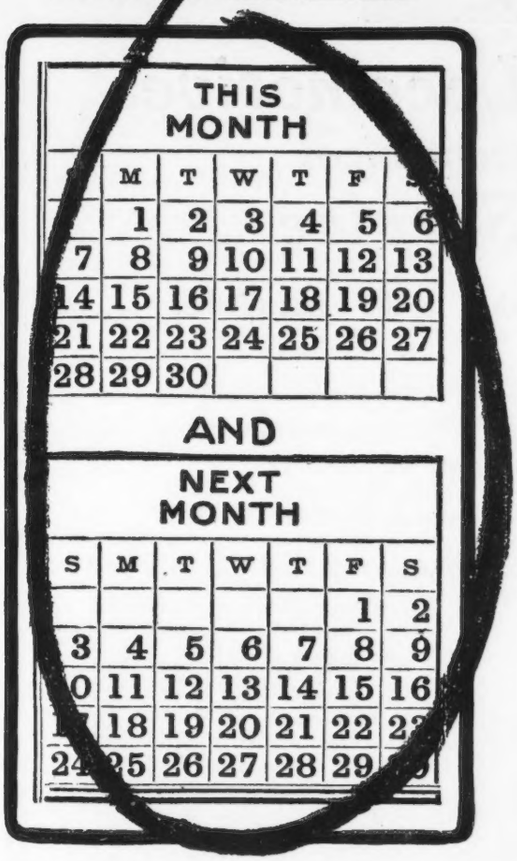
115 Broadway, New York **Laidlaw Works: Cincinnati, Ohio**

Atlanta Boston Buffalo Chicago Cincinnati Cleveland Denver Detroit El Paso Houston Kansas City
Los Angeles New Orleans Philadelphia Pittsburgh St. Paul St. Louis Salt Lake City San Francisco Seattle

L2618

Try FLEXOID TUBING 60 Days—at Our Risk

Prove to your own satisfaction, right in your own mine, that it *Saves Time.* Your men can return to work within 10 minutes after each shot. The fumes are literally blasted out of the workings. Your men can work full shifts—it is never necessary for them to lay off on account of powder headaches or to get fresh air.



Lowers Temperature

Immediately after installation you will notice a reduction in temperature and within a few weeks the temperature should be reduced about 20 degrees. The humidity will also be lowered about 30 per cent., thereby providing conditions very similar to those above ground.

Lost Time Eliminated

Lost time is the biggest loss you have to contend with. You can eliminate 75% to 90% of the lost time, when Flexoid Tubing is in use.

Ease of Installation

Flexoid Tubing is light in weight and may be quickly installed by anyone without special tools in a few hours' time. It goes around bends, up stopes—ventilates dead ends, and hot boxes perfectly. Can be suspended from the roof or laid along floor.

Pays for Itself

After the first cost, the cost of maintenance is hardly to be considered. After the first few weeks it will have paid for itself. It will then continue to pay you big dividends in the shape of increased output.

Absolutely Guaranteed

Flexoid Tubing is absolutely and unconditionally guaranteed. There are no "ifs" nor "ands" about it. We know that Flexoid Tubing will do all we claim, and that's why we urge you to try it 60 *days at our risk.* If at the end of that time you think you can afford to be without it, send it back—and you will be under no obligations whatsoever. Unless we knew what Flexoid would do for you, we could not afford to make this offer. So we ask you to take advantage of it. Write us today. Enclose a rough outline of your workings and give us a chance to show how you can increase your output 40% to 60%.

Bemis Bro. Bag Co.
465 Poplar Street
St. Louis, Mo.

Storage Battery Locomotives
are successful and economical
for Hauling Service

Some mining men are still unconvinced as to the value of the Storage Battery Locomotive.

As a matter of fact, the Storage Battery Locomotive has several points of superiority over other methods of hauling.

The Storage Battery Locomotive possesses the flexibility of mule haulage with the advantages of the ordinary electric locomotive. It can go into low workings that a mule could not reach, it does away with the dangerous trolley wire—a constant menace to the men's safety—it saves time and bother in turning and watching trolleys, and eliminates the cost of trolley wire, feeder and rail bonding and the upkeep and repairs on these. No waiting for wires to be strung and rails bonded. Production is gotten out quicker.

The Storage Battery Locomotive gives an *off peak load* to the power plant, thereby increasing the capacity of the plant for other work.

Edison Batteries give the Storage Battery Locomotives a sureness of service and a lowness of maintenance cost not possible any other way. They are the *only* batteries made of iron and steel, with the strength to stand up under actual working conditions. Many Edison Batteries installed five and six years ago are still giving full rated capacity, with no replacements of plates and practically no repairs.

Specify "Edison" for your Storage Battery Locomotives.

Let us send you details. Ask for new Bulletin 608-E.

EDISON STORAGE BATTERY COMPANY

Factory and Home Office: ORANGE, N. J.

Distributors in

New York Boston Chicago Detroit San Francisco Seattle New Orleans

ANACONDA INDORSES PACIFIC REDWOOD TANKS

The Anaconda Copper Mining Company in 1916 purchased seventy-five (75) Pacific Tanks, valued at more than Fifty Thousand Dollars.

The selection of Pacific Tanks was made because of their record for long continuous service under every conceivable condition however adverse.

This is an example you can afford to follow.

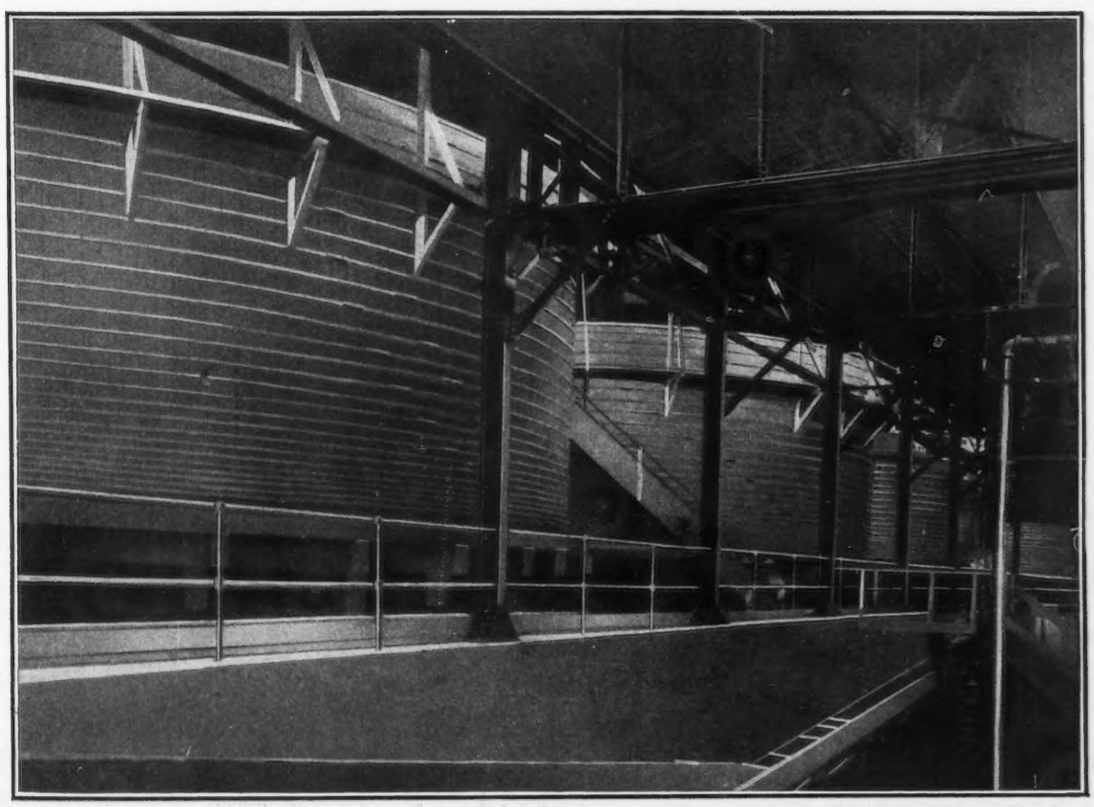
Write for catalogs, prices and specifications.

PACIFIC TANK & PIPE COMPANY

304 Market St., San Francisco **903 Trust and Savings Bldg., Los Angeles**

BURTON-COTTON LUMBER CO.

808 Walker Bank Bldg. **Rocky Mountain Agents** **Salt Lake City**



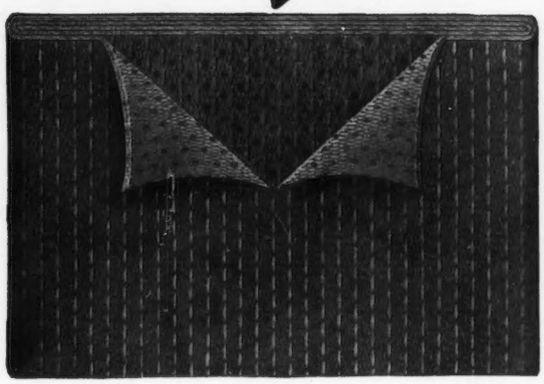
Here's How

To Account for the Lasting Qualities of REXALL

Double-Stitched Belting

Belting problems are solved by the high standard enduring qualities of Rexall Belting. The highest grade duck woven from superfine long-staple cotton and a filler so wonderfully perfected as to prevent hardening; a self-lubricating quality and a composition that is proof against rotting—these are some of its practical qualities. They spell MAXIMUM RESULTS on your conveyor or elevator.

Write or wire for samples.



IMPERIAL BELTING CO., Lincoln and Kinzie Streets, **Chicago**

42 Broadway, New York, N. Y. 525 Market St., San Francisco, Cal. 423 Yeon Bldg., Portland, Oregon

Butchart Concentrating Tables
Are the Best Money Will Build

Fully enclosed, self-oiling drive mechanism. Carefully constructed sliding bearings, running in oil. Best tilting device ever made. No wood used except in deck. Latest and best feed and water distributors. Butchart riffling is the most efficient yet produced. Every improvement embodied in Model No. 3.

Originator of
Deflected riffling.
Self-oiling drive.
Sliding bearings.
All metal mounting.

Sold on Merit, not on Price Competition.

W. A. Butchart, 605-607 Mercantile Building, Denver, Colo.

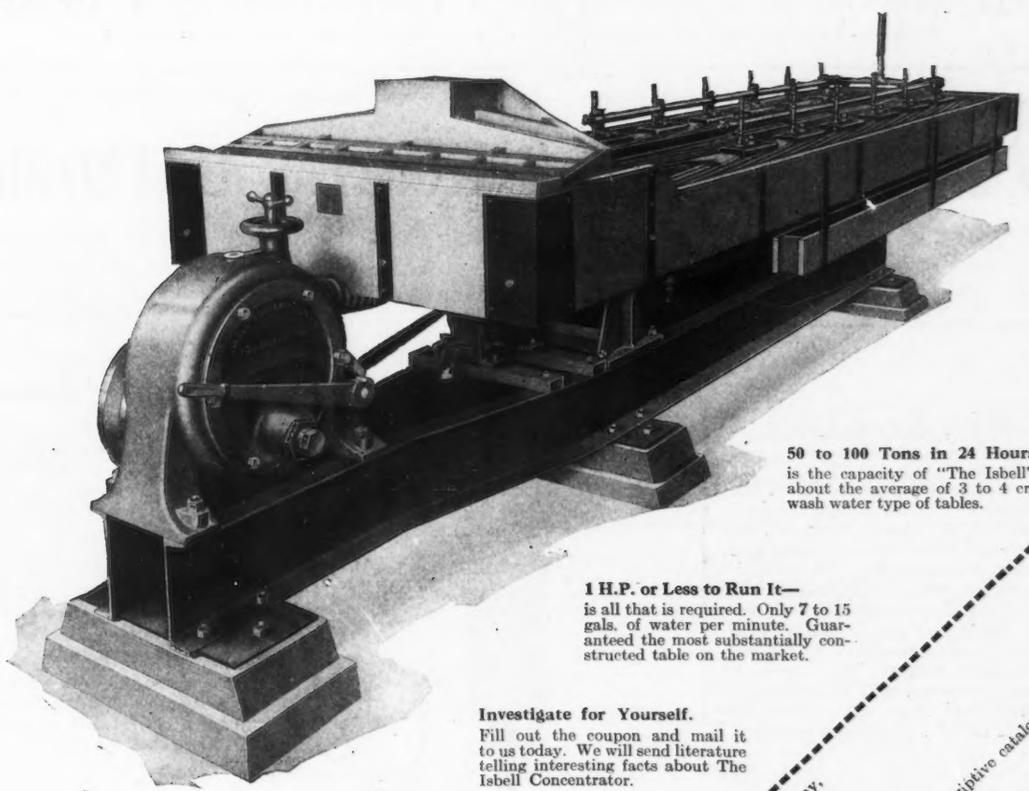
As Efficient as a Gold Pan

The accuracy of the gold pan in concentration is conceded by leading authorities. In fact it is used as a test to determine the concentrating values of devices in mill systems. It is now possible by simple mechanical devices to separate continuously the mineral particles from the gangue. This is accomplished by

THE ISBELL CONCENTRATOR

The only Concentrator Entirely Eliminating Classification. It entails no loss of slime values, because no cross wash water is used—no sizing is required; it treats a mixed feed direct from 6 mesh to 80 mesh screens.

Saves cost of Classifiers, Fine Jigs, Settling Tanks, Slime Tables or Vanners, and the necessary additional Power, Water, Shafting, Hangers, Pulleys, Belting, Labor, etc.



50 to 100 Tons in 24 Hours— is the capacity of "The Isbell"—about the average of 3 to 4 cross wash water type of tables.

1 H.P. or Less to Run It— is all that is required. Only 7 to 15 gals. of water per minute. Guaranteed the most substantially constructed table on the market.

Investigate for Yourself.
Fill out the coupon and mail it to us today. We will send literature telling interesting facts about The Isbell Concentrator.

Isbell Concentrator Company
716 North Main Street, Los Angeles, Cal.
Sole Manufacturers

Isbell Concentrator Company,
716 N. Main St.,
Los Angeles, Cal.

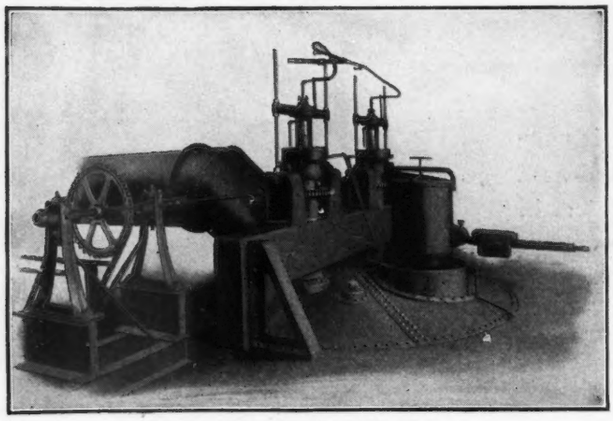
Kindl me your full descriptive catalog.

Name.....

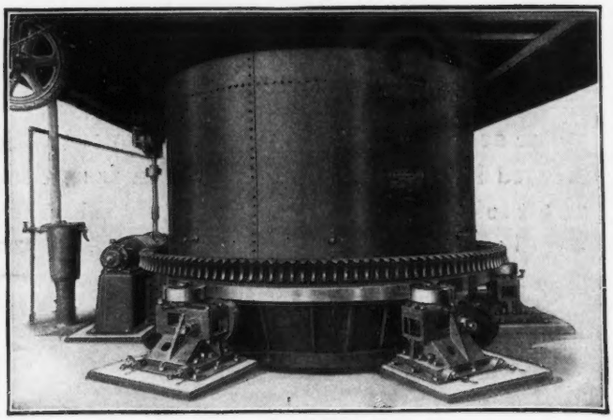
Address.....

REDUCED OPERATING COSTS

will follow the use of these producers in connection with your smelting and roasting furnaces.



Stationary Section, with Stirring Gear.



Revolving Section, with Worm Gear Drive.

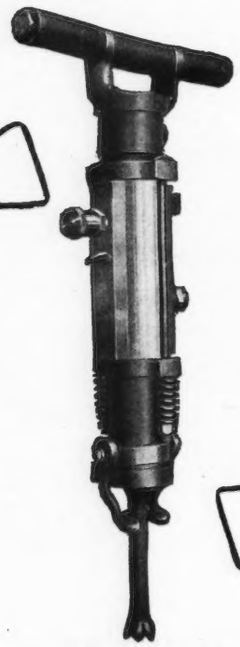
"The Wood Mechanically Operated Gas Producers"

excel in economy and quality of the gas, and effects a large saving in labor, as no hand poking is necessary even under continuous maximum production. One producer gasifies 3,330 lbs. of coal per hour, and the gas contains from 26 to 28% CO.

R. D. WOOD & COMPANY, PHILADELPHIA, PENNA.

Makers of Centrifugal Pumps, Cast Iron Pipe, Fittings, Valves and Special Castings.

No. 66 "Wondersinker" Means Low-Cost Drilling



Why Low Cost

In the first place the No. 66 is as low in price as inferior drills of the same size. Next, it will produce more feet of holes in a given time than any drill of corresponding size having the same air inlet. Third, it uses less air in doing more work. Fourth, it gives uninterrupted service, day in and day out, regardless of conditions, because of its ruggedness and simplicity. The saving of power combined with the increased footage will more than offset the cost of the No. 66 in a few months.

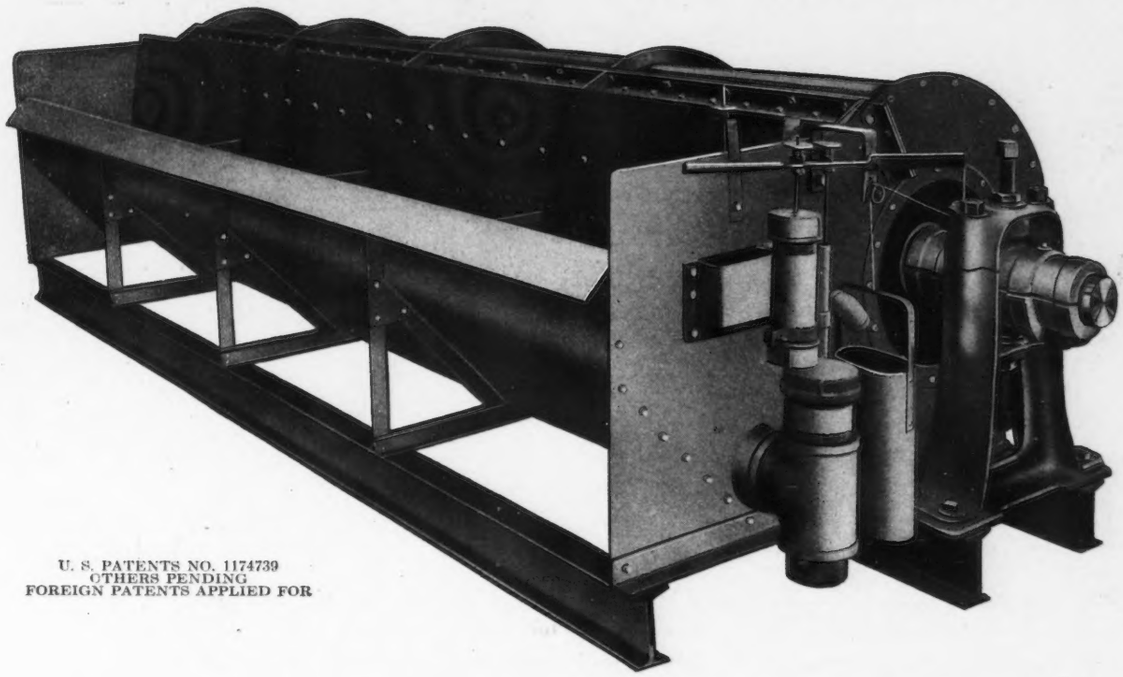
"Wondersinker" Features

Hardsocg features tell the story of "Wondersinker" economy. It is self-rotating, has a full rubber handle, exhaust control, automatic oiler, shock absorber, and the best and most satisfactory bit retainer ever attached to a drill. It works on a protected spiral compression spring—the kind that never breaks. There are very few parts—nothing to get out of order—and the whole machine weighs only 40 lb.

It takes a special bulletin to describe this wonderful drill in detail. We have a copy ready to mail to you. Where shall we send it?

Hardsocg Wonder Drill Co., Ottumwa, Iowa

K. & K. FLOTATION MACHINE



U. S. PATENTS NO. 1174739
OTHERS PENDING
FOREIGN PATENTS APPLIED FOR

Cuts the High Cost of Milling

It's a complete flotation unit in itself. One machine, 14 x 4 ft., has a capacity of from 80 to 150 tons per 24 hours, and requires 8 H.P. or less. It produces the desired effect of both aeration and agitation; it is a combination of the pneumatic and agitation type of machine.

We offer a substantially constructed machine in either wood or steel. SKF self-aligning ball bearings, inclosed in grit-proof housing, are used. Requires practically no attention. Only wearing parts are riffles which, on ordinary flotation feed, last 3 to 4 months. We also supply a steel riffle, the life of which is from 6 months to a year.

In taking air from atmosphere and introducing it directly into the pulp, as is done in the K. & K. Machine, the aeration is carried to a point further than is possible by forcing air through a porous medium, and without the ill-effects of violent agitation.

Some Users of K. & K. Flotation Machines

Federal Lead Company
Ray Consolidated Copper Co.
Butte & Superior Mining Co.
Oro Grande Mining Co.
Silverado Mining Co.
Rose Chemical Co.
Weringer Mines Co.
Searadale & Drake
Encomotas Copper Co.
Progress M. & M. Co.
Kennecott Copper Corp.
Federal M. & S. Co.
Silver King Mining Co.
Rutherford Mining Co.
Arizona Molybdenite Mining Co.
National Lead Co.
Des Loge Cons. Lead Co.
Santa Xavier Mining Co.
Sunshine Copper Co.
Pacific Ore Testing Co.
J. H. Hancock
Aparo Mining Co.
Compania Explotadora de Minas
La Blanca Mines Co.
Real Del Monte
Hawke Milling Co.
San Rafael
Shattuck-Arizona Copper Co.
Simonds & Latham, Melones, Cal.
Nevada Cons. Copper Co.
Moctezuma Copper Co.
Prince Cons. Mining Co.
Fortuna Mining Co.
Goodwill Mining Co.
Burro Mt. Copper Co.
Old Dominion Copper Mining & Smelting Co.
Detroit Copper Mining Co.
Cerro de Pasco Mining Co.
Chino Copper Co.

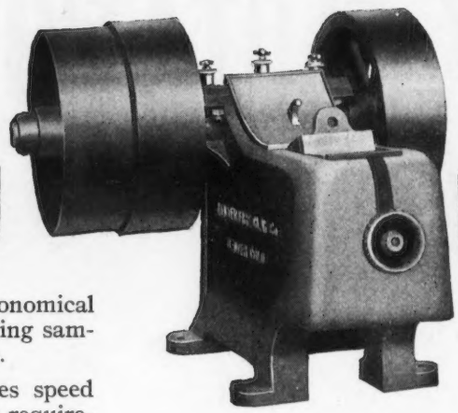
Write so that we may explain further.

Southwestern Engineering Company, Inc.

106 W. 3rd Street, Los Angeles, California

Case Improved Crusher

"1915" Model



Fast
Strong
Efficient

A crusher designed for the economical handling of such work as crushing samples for large mills and smelters.

This modern machine combines speed and strength with lower power requirements.

There are many distinctive features which will appeal to the mining engineer, among them being the ease with which the Case Crusher can be cleaned. Cleaning can be so thorough that there can be no possibility of salting.

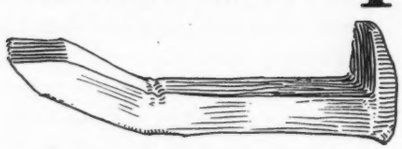
Size No. 1—For Laboratory Work—(Hand Power) just the right machine for an Assay Office—Write for latest bulletin with complete details.

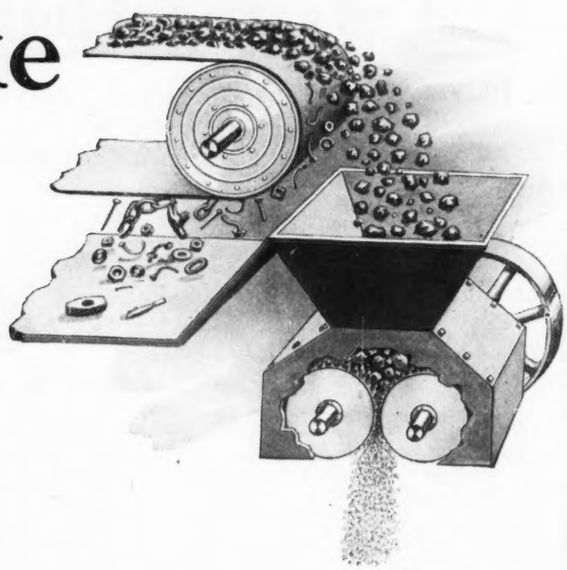
DENVER FIRE CLAY CO. PRODUCT

HAVE SURVIVAL VALUE

Denver Fire Clay Company
Denver, Colo., U. S. A.

A Track Spike





Rusted—nicked—bent! This spike caused damage. It got in the feed of a crusher—stalled the crusher—disabled it—tied things up. Crippled the output. The total toll was over $300.

And the owner of the plant could have completely warded off this trouble by using

DINGS
MAGNETIC PULLEYS

They remove all forms of tramp iron. Used as head pulleys of belt conveyors. They are 100% efficient. A very low cost form of crusher insurance. Get further data now. Write.

Dings Magnetic Separator Co.
673 Smith Street, Milwaukee, Wis.

Dings Magnetic Separator

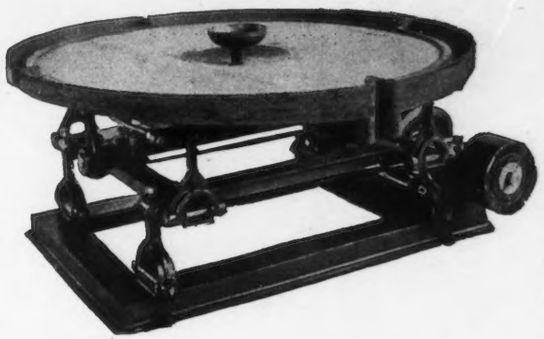
Dings Magnetic Separators are built in standard and special designs to meet requirements for smelters and refiners, zinc, lead, tin mines, etc.

Send samples of your ore for preliminary tests. Our laboratory and engineering department are at your service for the solution of your problem.

Why Trust to Luck to Save Gold

but take such pains to save the concentrates?

In tests made by the General Engineering Co., the Senn Batea Amalgamator Jr., amalgamated 97% of the gold from Neill Jig concentrates. Of this gold 55% passed 100 mesh.



Can You "Pan" Free Gold in Your Plate Tailings?

The Victor recovered 14 ounces of amalgam on the Senn Batea Amalgamator from stationary plate tailings, to 20 ounces on the plates.

An increase of 25 cents per ton means an increase of $375.00 per month for each Senn Batea.

Why Not "Pan" the Gold into the Amalgam?

In tests by Chas. Butters Co. on a silicified shale carrying free gold, the best of four laboratory bottle-amalgamation tests gave 58.5% recovery. Two mill runs on the Senn Pan-Motion Batea Amalgamator gave 78% and 82.5% respectively.

We are furnishing 4 Bateas for the first unit of the mill to handle this ore.

Why Not Grind Fine and Save All the Free Gold?

63% of the gold in the latter tests passed through 150 mesh, while 91% of it passed 40 mesh.

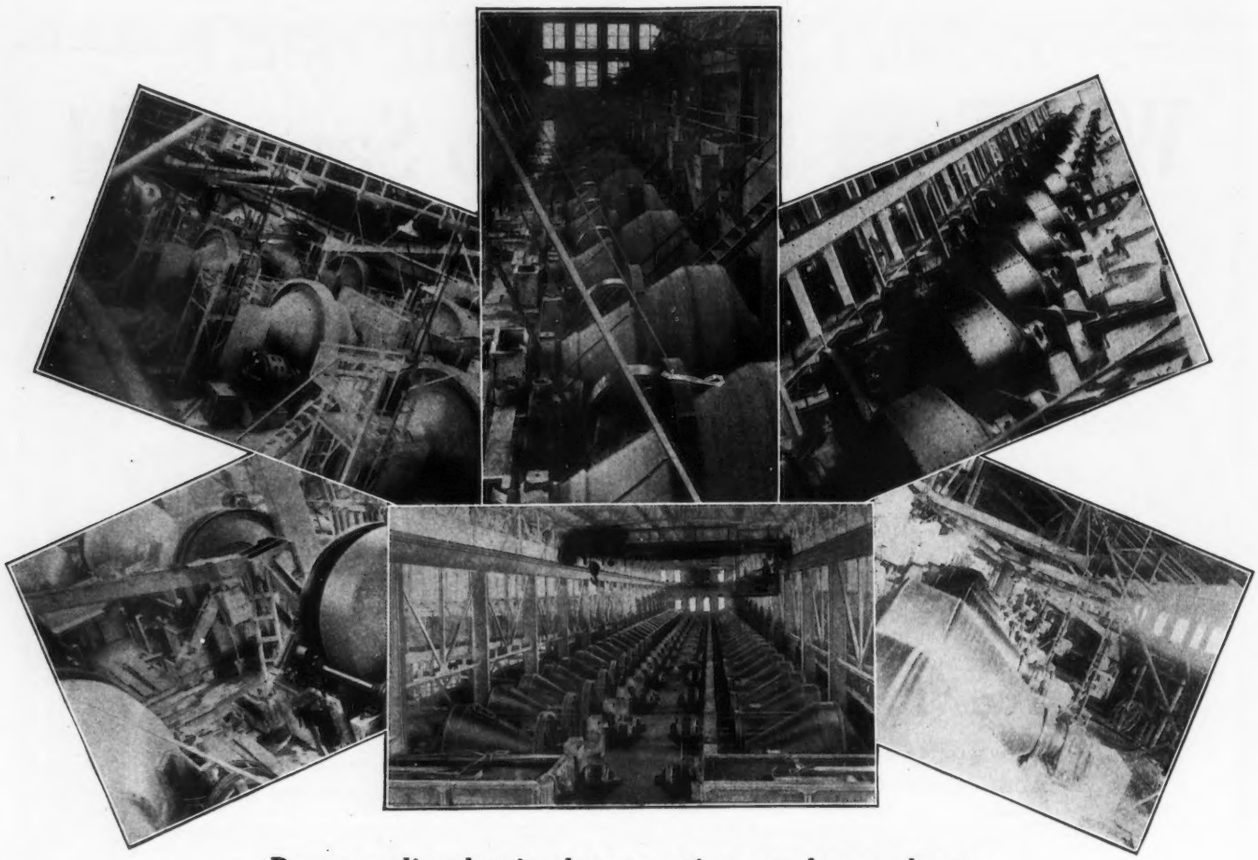
Senn Pan-Motion Batea Amalgamators

are made in two sizes—a 50-ton machine for general mill installations, and a 20 to 25-ton Batea (shown above) for test plants, small mills, clean-up plants, cleaning placer concentrates, etc. They are carefully and strongly built for continuous operation with a minimum of attention.

SENN CONCENTRATOR COMPANY

611 FIRST NATIONAL BANK BUILDING, SAN FRANCISCO, CAL., U. S. A.

Cor. Post and Montgomery Streets



Do you realize that in plants treating even low-grade ore

The Cost of Shut-Down Is Enormous

Based on 1½% copper ore, normal extraction and present market prices the cost of shut-down in a few well-known concentrators is as follows:

	Daily Tonnage	Cost of shutdown Per min.	Per hr.	Per day
Consolidated Copper Mines Co.	500	$2.60	$156.25	$3,750
Miami Copper Co.	5,000	26.05	1562.50	37,500
Nevada Consolidated Copper Co.	12,500	65.10	3906.25	93,750
Inspiration Consolidated Copper Co.	17,000	88.50	5312.50	127,500

370 DAYS WITHOUT A MOMENT'S SHUT-DOWN is the record of the first **HARDINGE CONICAL BALL MILL** installed at the Concentrator of the Nevada Consolidated Copper Co.

A MILL THAT NEVER STOPS is the one that you should install; that mill is **CONICAL** in shape and is SIMPLICITY PERSONIFIED.

Hardinge Conical Mill Company

120 Broadway, New York, N. Y.

London Office: Salisbury House

San Francisco Office: Balboa Building

Salt Lake City: Newhouse Building

Cable Address: Halharding, N.Y.

THE FLOTATION PROCESS

All patent and other rights to this process in North America are now controlled by

MINERALS SEPARATION NORTH AMERICAN CORPORATION

On December 11, 1916, the SUPREME COURT OF THE UNITED STATES adjudged our basic patent for *air-froth flotation* to be valid, holding that this patent covers any process of froth flotation wherein the *results obtained* are secured by the use of a fraction of one percent, on the ore, of an oily frothing agent in an ore-pulp, with agitation. Three of the thirteen claims which specified the use of "*a small quantity of oil*" and which the Court held to be invalid have since, by proper disclaimer, been brought within the scope of the Supreme Court's decision and, at a recent trial in the United States District Court at Butte, Montana, Judge Bourquin admitted these claims as amended.

On May 24, 1917, the UNITED STATES CIRCUIT COURT OF APPEALS at Philadelphia, in the case of Minerals Separation, Ltd., against Miami Copper Company, unanimously sustained the validity and broadly construed *a second basic patent*, owned by us, for the use of *all "Soluble Frothing Agents."* In the same opinion, the Court also validated a third patent for the use of cresols and phenols in the cold and without acid. The defendants, Miami Copper Company, endeavored to avoid infringement of these patents by using Callow pneumatic cells, but the Court held that the operations of the defendant company infringed all three patents.

Prospective users of our flotation processes are earnestly requested not to be misled by the mistaken views disseminated by interested parties that any of these BASIC PROCESS PATENTS can be evaded by a mere variation of apparatus for agitating and aerating the pulp, or by the simple addition of oils or other materials in excess of a fraction of one percent on the weight of the ore treated.

NOTICE

Notice is hereby given that we will enforce our patents and stop all infringements, but are prepared to grant licenses for the right to use all or any of our processes to those who wish to use them.

To those who infringe or have infringed our patents, notice is given that A SETTLEMENT FOR SUCH INFRINGEMENT MUST PRECEDE THE GRANTING OF LICENSES FOR THE FUTURE USE OF SAME.

Notice is further given that no one is authorized to introduce our processes or apparatus into the United States, Canada or Mexico.

All applications should be made direct to

MINERALS SEPARATION NORTH AMERICAN CORPORATION

Head Office
61 Broadway
New York, N. Y.

Engineering Office
Merchants Exchange Building
San Francisco, California

Westinghouse

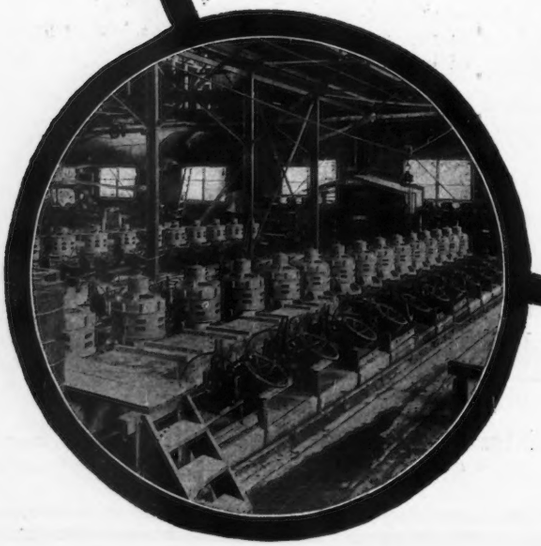
Unfailing Dependability

of Westinghouse Type CS Agitator Motors make them premier for this service. This is demonstrated by over 1000 in service. They are designed throughout for this particular service and give better operating results than a motor merely adapted for this application.

The construction of the motor is sturdy and extra heavyto resist vibration. The bearings have a special oiling system insuring adequate lubrication at all times. The shaft and guide bearings are proportioned to withstand the thrusts that are apt to be encountered. The lower bearing sleeve is of non-corroding alloy.

So with these excellent construction features to insure UNFAILING DEPENDABILITY you cannot beat the Westinghouse Type CS Agitator Motors for Flotation Plants.

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.



W
WESTINGHOUSE ELECTRIC

Speed up with Electric Power

G-E Arc Welders control current, heat, and metal building; and do their own chipping

HERE are some of the ways in which modern industry has been speeded up by putting electric power to work in the right place.

Metal mines have boosted output to meet world-wide demands. Great central power plants in place of small local plants in coal mining areas now supply cheaper electric power per ton output for each mine. All tonnage records have been smashed in the steel industry. Greater automobile output has lowered prices and given better road transportation. More and better cloth has been produced at lower power costs.

The engineering problems solved in putting electric power to work in these and other industries were many and intricate. Production of electrical equipment suited to this work and in quantities required is an important part of this company's service to American industries.

Any problem involving the use of power can be simplified by the application of electricity. The General Electric Company is well equipped to lend valuable assistance in working out such problems and is glad to co-operate with manufacturers and engineers in every possible way.

G-E Arc Welding Outfits

GENERAL ELECTRIC COMPANY

General Office, Schenectady N.Y. Sales Offices in all large cities

7150

SEARCHLIGHT SECTION

Employment Department

POSITIONS VACANT

ADVERTISEMENTS ARE KEYED

to our office nearest the advertiser. The advertiser's location is indicated by the State abbreviation following the box number.

IN REPLYING

be careful to put on envelope the key number in the ad. and also local address of office to which reply is sent.

10th Ave. at 36th St., New York.
1144 Monadnock Block, Chicago.
Real Estate Trust Bldg., Phila.
Rialto Bldg., San Francisco.

IMPORTANT

Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents—send copies. Advertiser's names will not be furnished under any circumstances. Copy received until 10 a.m. Monday for following Saturday's issue.

EXPERIENCED mill man needed for a small zinc lead property 100 miles below American Border in Mexico; state salary desired. P651—Eng. & Mining Journal.

MASTER mechanic with experience in mine and smelter work wanted for industrial works in Delaware. P716 (Del.)—Eng. & Min. Journal.

SUPERINTENDENT familiar with general machine-shop practice, tool and die making, light manufacturing; man capable of developing system and handling men. P733 (N. J.)—Eng. & Min. Journal.

POSITIONS VACANT

A FOREMAN wanted for a small mill who is expert in concentration; a fine opportunity for the right man who will consider a permanent position with a manufacturing concern. Address Hampden Corundum Wheel Co., Springfield, Mass.

EMPLOYMENT AGENCIES

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CUPELMAN, retortman, refinery man (three openings); silver-lead refinery, Asia; Dwight-Lloyd furnaces, H. & H. pots; large English company; two-year contracts; transportation paid; good living conditions; salaries $175 to $250. Apply Business-Men's Clearing House, Denver, Colo.

CORRESPONDENCE SERVICE

THE undersigned provides a confidential service designed to locate openings, through correspondence, for men earning not less than $2500 and up to $25,000; all lines. Not an employment agency, but a constructive, initiative service, covering individual negotiations. Established 1910. Complete privacy assured; present connections in no way jeopardized. Send name and address only for explanatory details. R. W. Bixby, W1 Niagara Square, Buffalo, N. Y.

CIVIL-SERVICE OPPORTUNITIES

ASSISTANT chemist (1st Dist.); salary, $1201-$1500. Apply State Civil Service Commission, Albany, N. Y.

POSITIONS WANTED

MANAGER technical graduate; 19 years' practical experience operating, designing, erection; well versed in mining and metallurgy of gold, silver, copper, lead and zinc ores; good executive ability; well qualified handle Spanish labor; past 18 months have been engaged in flotation complex silver, copper, lead, zinc ore; interview in New York. PW722 (N. Y.)—Eng. & Min. Journal.

PROSPECTOR, Latin-American experience, speaks Spanish, open for engagement; best of references. PW717—Eng. & Min. Journal.

PHYSICIAN desires position with railroad or mining company in Spanish America, China or Russia; large experience in medical contract work; references. PW 715 (Pa.)—Eng. & Min. Journal.

POSITION wanted by young man as assistant to mine superintendent or assistant mining engineer; has had several years' practical experience as shift boss, top foreman, etc.; technical education. PW 721 (Va.)—Eng. & Min. Journal.

MANAGER or assistant manager, technically trained, thorough, aggressive executive, desires Canadian or United States connections; will consider contracts for foreign service as well. PW718 (Tenn.)—Eng. & Min. Journal, Chicago.

ACCOUNTANT and executive, age 33, for past 10 years employed by large metal mining company, desires position as office manager or traveling auditor; best references. PW719 (Pa.)—Eng. & Min. Journal.

PROSPECTOR, thoroughly familiar with vanadium, molybdenum and tin ores, particularly their surface, indications, wants position as prospector with strong company. PW724 (Colo.)—Eng. & Min. Journal.

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With Pack Trains

Men of experience in the pack train service of the army or similar line of civil life. Only those possessing the requirements prescribed for recruits for the Field Artillery should be interested, as the service is arduous.

"DO YOUR BIT"
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UNCLE SAM
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PACK-MASTERS
Will You Come?

Men of experience in the pack-train service of the Army or similar line in civil life, capable of taking charge of a pack train, composed of 50 pack mules and 13 men—should be capable of setting up a pack saddle, packing same, etc., and able to impart instructions in this connection and in the care of mules.

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EXPERIENCED
Labor Overseers
ARE NEEDED
IN THE
U. S. ARMY

If you have had experience as a boss or overseer over construction gangs, or any laboring body of men—the U. S. ARMY can use you to good advantage.

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We'll Find You the Right Man for the Right Place—

We keep in touch with a hundred mining camps and the most competent Superintendents, Milling Experts, Assayers, Engineers, Mechanics, Mine Accountants, Etc., available for engagement. Each is an expert in his line. If you need a man, write or wire us. No charge to ou.

Fifteen years in this work.

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Technical men, practical mine or mill men, office men.
Competent mining man of technical and practical training in charge of mining department.
Men using Spanish a specialty. Wire, cable or write us your needs.
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7—No. 4, perfect condition, complete with new riffles, practically unused. Immediate delivery.
2—No. 2, good condition.
2—No. 6, with new type riffles, steel frame, perfect.
SOUTHWESTERN WRECKING COMPANY
El Paso, Texas

SEARCHLIGHT SECTION

Miscellaneous

POSITIONS WANTED

MINING engineer, 13 years' experience in mining, cyaniding, concentration and management; age 37; married; open for engagement after June 1; good references; Denver interview. PW723 (Colo.)—Eng. & Min. Journal, San Francisco.

MINING ENGINEER, open for engagement, development, organization, reporting, geology; 25 years' practical experience over several home states and foreign countries, including Spanish America. PW732 (N. Y.)—Eng. & Min. Journal.

TECHNICAL graduate; practical experience in copper mining, mucker to superintendent; chief engineer biggest copper mine, Mexico; New York interview. PW731—Eng. & Min. Journal.

MINING engineer with considerable experience as superintendent, manager and consulting engineer, residing in Mexico City, offers his services to serious enterprise. PW730 (Mex.)—Eng. & Min. Journal, San Francisco.

MANAGER or general superintendent; technical training, Yale and Michigan College of Mines; recently directing large copper-producing property in Mexico; also copper smelting experience; age 47; married; references. PW725 (Ariz.)—Eng. and Min. Journal, San Francisco.

TECHNICAL graduate, three years iron, Mesabi Range, two years porphyry copper, fifteen months reinforced concrete, wants position with reliable company where brains count. PW726 (Ariz.)—Eng. & Min. Journal, San Francisco.

POSITION wanted, by experienced bookkeeper, office man and accountant; at present connected with large company; desires position in Mexico, South or Central America; experienced in smelting, concentrating, power, etc., cost work, pay-roll work, material and labor distributions, etc; 28 years of age, speak Spanish fluently; excellent recommendations. PW727 (N. Mex.)—Eng. & Min. Journal.

POSITIONS WANTED

EXPERIENCED lead refinery superintendent wants position about September first; A-1 references. PW729 (Idaho)—Eng. & Min. Journal, Chicago.

AGENTS AND SALESMEN

Sales Engineer Wanted

Sales engineer of ability and experience with ore-treatment machinery; fine opportunity for one who can make good. W720 (Colo.)—Eng. & Min. Journal.

WANTED

Used Carbon (Black Diamonds) and Bortz

and fragments wanted; will pay highest prices. S. Dessau's Son, 180 Broadway, New York, N. Y.

Ores or Concentrates Wanted

Molybdenite, wulfenite and vanadium ores or concentrates in large tonnage monthly—5000 tons chromite, 10,000 tons magnesite, 20,000 tons manganese, 10,000 tons barytes, 5000 tons bauxite, 1000 tons antimony and platinum ores. W705 (N. Y.)—Eng. & Min. Journal.

Manganese Ore

wanted, testing 50% metallic manganese or better. Submit offers to General Metallic Oxides Company, 10 Wall Street, New York.

Crude Talc

wanted. State tonnage, deliveries, etc. and submit samples. Submit price per long ton to General Metallic Oxides Co., 10 Wall Street, New York.

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EXPERIENCED prospector wants backing to prospect certain promising localities in New Ontario for either molybdenite, iron pyrites, gold or iron. W728—Eng. & Min. Journal.

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OWNERS of a group of high-class copper claims in the Copper River valley, Alaska, desire to meet capitalist to develop, incorporate same or will sell on easy terms; will stand investigation. Chas. Young, Strelna, Alaska.

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for sale cheap; weight 1000 lb. each; iron work complete for two Joshua Hendy ten-stamp batteries; also 2700 ft. ¾-in. wire rope at 15c. per foot and 7000 ft. ⅝-in. wire rope at 10c. per foot. Original Amador Consolidated Mines Co., Amador City, Calif.

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Patented and unpatented, for sale, bond or lease on famous Comstock Lode and vicinity. Address Box 622, Virginia City, Nevada, care of J. J. Quinlan.

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Claim 828-829-830 and 831, situated in **Doloro Township**, in the midst of the richest portion of the **Porcupine** district. Immediately adjoining the new holdings of the **Coniagas Company** just south of **Tisdale**, directly south of the **Hollinger Consolidated, McIntyre, Vipond** and **Porcupine Crown Mines.** Thirteen veins and ore bodies have been exposed, some of which are of exceptional value. Owners are unable to devote time to development and wish to sell to **principals only.** Terms—write.

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Care of The Art Metal Mfg. Co.,
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Located in Virginia, 100-ft. Shaft, several drifts all in 7½% ore, 48 to 60 in. wide.

This property is fully equipped and nicely developed. Present owners offer same for sale, or will entertain proposition for operating on percentage basis.

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16 Years in Mexico

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4—100-H.P. Standard tubular boilers.
3— 80-H.P. Standard tubular boilers.
These boilers are in unusually good condition and are complete with stacks and all fittings. *Write for quotations to*

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SEARCHLIGHT SECTION

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CHICAGO HOUSE WRECKING COMPANY

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No. C-1105—1—5 x 7-in. Flory double cylinder, single drum hoisting engine.

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No. C-1778—1—14 x 36-in. Vilter L.H. Corliss engine. Girder Frame.
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No. P-3100—13—73-ton American, std. g.
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No. P-3105—22—63-ton American, st'l. g.

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No. C-1500—2—22 x 14 x 14 x 18-in. steam Duplex air compressor.
No. C-1893—1—18 x 12 x 12-in. Ingersoll Sargeant belt driven air compressor.
No. K- 318—1—12 x 12-in. Chicago Pneumatic, capacity 275 cu.ft. per minute.
No. K- 179—1—14 x 16-in. Chicago Pneumatic, capacity 400 cu.ft.per minute.
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You can get the valves you need now at big price reductions.

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No. C- 411—50—Horizontal and vertical centrifugal pumps, Lawrence and Buffalo makes, 1-in. suction, 1¼-in. discharge to 10-in. suction and 8-in. discharge.
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No. C-1135—5—Close type diaphragm pumps, 4-in. suction, direct connected to 3 H.P. Olds gas engine.
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No. P-3209—1—Thew steam shovel, ¾-yd. dipper.

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No. C-1109—1—No. 3 Gates gyratory, style D

DERRICK

No. C-1155—1—Guy Derrick, 80-ft. boom, 80-ft. mast with sheave wheels, guy wires and irons complete.

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If you want machinery quickly, write us. We can make immediate delivery of almost anything required.

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1—8 x 9 x 12 Leyner
1—10 x 10 x 10 Smith-Vaile
1—12 x 13½ x 8½ x 16 Leyner compound
1—10 x 16 x 9 x 14 Rand Imperial, Compound
2—14 x 14 x 22 Rand, Class C
1—14½ x 16 x 10 x 17 Leyner, compound
1—14 x 16 x 9½ x 16 Norwalk, compound
1—11¼ x 20¼ x 18 x 11 x 22 Leyner compound
1—16 x 18 x 11 x 22 Leyner compound
1—18 x 20 x 13½ x 20 Norwalk compound

BELT DRIVEN COMPRESSORS

1—8 x 8 Bury, single
1—11½ x 6½ x 14 Leyner, compound
1—14½ x 9½ x 8 Ingersoll-Rand, compound
1—24½ x 14½ x 14 Ingersoll-Rand, compound

ELECTRIC LOCOMOTIVES

2—10 ton Baldwin-Westinghouse, Standard gauge, 250 volt
2—7-ton Jeffrey, 30 in. gauge, 250 volt
1—5-ton General Electric, 24 in. gauge, 250 volt
2—3-ton Jeffrey, 24 in. gauge, 250 volt

STEAM LOCOMOTIVES

1—50-ton Shay, 36 in. gauge
3—50-ton Baldwin, Standard gauge

BLOWERS

1—85-cu.ft. Piqua positive blower
1—24-cu.ft. Connersville positive blower
1—No. 5 Root positive blower
5—No. 5 Baker positive blowers
1—No. 3 Garden City positive blower
1—No. 2 Garden City positive blower
1—No. 10 Sturtevant Monogram blower
1—No. 6 Sturtevant pressure blower
1—No. 1 Buffalo pressure blower

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1—12½ Kw. Crocker-Wheeler, 25 volt, 300 r.p.m. Generator, direct connected to Mietz & Weiss oil engine
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1—8 ft. Steel plate mine fan, engine driven
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3—No. 7 Sturtevant Monogram exhausters
1—No. 7 Buffalo volume exhauster
1—No. 6 Sturtevant Monogram exhauster
2—36 in. Sturtevant steel plate exhausters
7—35 in. National Steel plate exhausters

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2—20 Kw. Western Electric, 110 volt, compound wound, 650 r.p.m.
1—40 Kw. Crocker-Wheeler, 275 volt, type CCD 1200 r.p.m.
1—50 Kw. Westinghouse, 550 volt, 850 r.p.m.
2—50 Kw. Electrical Mchy. Co. 250 volt, 750 r.p.m.
1—55 Kw. Westinghouse, 250 volt, 800 r.p.m.
1—60 Kw. General Electric, 250 volt, 925 r.p.m.
1—62½ Kw. Milwaukee, 250 volt, 950 r.p.m.
1—65 Kw. Northern, 250 volt, 900 r.p.m.
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2—15 Kw. General Electric, 3 phase, 60 cycle, 1100 volt, 1200 r.p.m.
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Alternating Current

2—125 Kw. Westinghouse, 3 phase, 60 cycle, 440 volt Generators, direct connected to 16 x 16 Chuse automatic engines
2—200 Kva. General Electric, 3 phase, 60 cycle, 2300 volt Generators, direct connected to 18 x 20 Ridgway automatic engines

We also have for immediate shipment, a large stock of Direct and Alternating Current Motors for every requirement.

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Your Machinery Dollars Do More Work Here

2 six-foot Chile mills, 2 9x15 crushers, 3 electric locomotives, 4 steam locomotives, 100-hp. S. D. electric hoist, 150-kw. G. E. 2,300 V. 3 P. generator, Pelton 4-ft. wheel with governor, 4 Ry. steam shovels, new copper furnace, Connersville blowers 2 to 81-ft. contractor's hoisters, derricks, compressors, lighting plants, Corliss engines up to 800 hp., boilers and pumps, 7 electric and 14 steam mine hoisters. Write for prices and details on this slightly used machinery and save money.

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Ball and Tube Mills

The following in stock ready for Immediate Shipment

10—6 x 12 ft., either Manganese lining for ball work or El Oro or Silex for tube mills.
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4—5 ft. 6 in. x 16 ft. Tube Mills, El Oro or Silex.
1—5 x 22 ft. Tube Mill, Silex lined.
1—5 ft. 6 in. x 16 ft. Tube Mill, Silex lined.
1—4 x 15 ft. Tube Mill, El Oro lined.

The Morse Bros. Machinery & Supply Co.
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SILVER MINING PROPERTY

In Austin, Nevada, consisting of approximately 1200 acres, over half of which are patented. Last owned by Austin Manhattan Consolidated Mining Co. Includes old mines of the MANHATTAN SILVER MINING CO., with record production of over TWENTY MILLION DOLLARS. None of the old mines are deep.

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We offer for immediate delivery one 17 x 10 x 14 cross compound Ingersoll-Rand belt driven compressor, capacity 677 cu.ft. air, power required 100. Condition perfect, complete in every respect. Price $2100 El Paso. First order takes it.

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We make a specialty of, and have the largest stock of SECOND HAND electric MOTORS and GENERATORS in America, and buy and sell, rent, exchange and repair electrical machinery of all kinds.

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2—1100 cubic ft. Norwalk two-stage, steam-driven air compressors, in fine condition at a bargain; also drills, drill steel, etc.

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2500 tons 90 lb.
300 tons 75 lb.
3500 tons 70 lb.
300 tons 65 lb.
4000 tons 60 lb.
2500 tons 50 lb.
nearly all light weight rails.

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SEARCHLIGHT SECTION

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For Immediate Delivery

2—350 H.P. Wolf Cross Compound Superheated Steam **Locomobiles**, complete, with Condensors, Boiler Feed Pumps, Injectors and Feed Water Heater.

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2—Type B.L.C., 35 K.W.H., 850 R.P.M., 125 V., Belt Driven **Exciters**

8—Fort Wayne 60 cycle, 219 K.V.A. (175 K.W. 8-10 P.F.), 33,000 volt, primary to 480 volt secondary, single phase **Transformers.**

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1—Blue Vermont Marble **Switchboard**, with all necessary instruments.

8—3-phase Aluminum Cell **Lightning Arrestors.**

6—200 amp. **Coke Coils.**

Above equipment has been slightly used, but not misused, and is guaranteed to be in first-class condition. Power plant is for sale only as a whole.

Motors

2—50 H.P. 3-60-440-720 R.P.M. G.E. Motors.
1—40 H.P. 3-60-440-900 R.P.M., G.E. Motor
2—15 H.P. 3-60-440-900 R.P.M., G.E. Motors.

All above motors equipped with starting compensators, arranged for conduit wiring, no voltage release and overload relays.

Mill Equipment

1—32 in. x 10 ft. Gates **Revolving Screen.**
1—6 ft. x 16 in. Hardinge **Mill.**
2—32 x 15 ft. Dorr **Agitators** and **Tanks.**
2—36-in. Perrin **Presses**, 39 plates, 60 leaves.
1—6 x 9 in. Aldrich Vertical Triplex **Pump.**
1—42 x 48 in. Belt Driven A.C. Tube **Mill.**
1—52-in. Merrill **Precipitating Press**, 30 leaves.
1—No. 787 H-H-M Steel **Bullion Safe.**
1—42-in. Carlin **Grinding Pan.**
2—Erie City Economy **Boilers.**
1—3 x 2 x 4 Duplex **Boiler Feed Pump.**

Full Refinery Equipment.

Lot large Redwood Tanks, good condition.
Pulleys, Shafting and Transmission Equipment.

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1—50-ton F.M., 4 x 10 ft. **Track Scale**, with Type R Registering beam and steel frame.
1—7 x 10 double cylinder **Steam Hoist.**
1—15 H.P. Fairbanks **Gasoline Hoist** and 500 ft. rope.

Complete Boarding House Equipment.

Power Plant may be inspected at Beowawe, Nev. **Other material at Buckhorn, Nev.**

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DIESEL ENGINES Delivery NOW

1—175 H.P. direct connected to 125 K.W., 3 phase, 60 cycle Westinghouse generator. Used 3 months.
2—120 H.P. alone or with two D.C. 500 V. generator. These two have never been erected and are still in original crates. These three engines are the three cylinder vertical type. Photos and specifications on request. *Better wire.*

Southwestern Wrecking Co., El Paso, Texas.

FOR SALE
Lake Shore Engine Works
STEAM HOIST

Cylinders 10 x 12, drum 42 x 42 in.
Immediate delivery from Butte, Mont.

C. M. Everett, 14 Silver Bow Bldg., Butte, Mont.
H. L. Palmer, 307 Glencoe Bldg., Duluth, Minn.

FOR SALE
Steam Hoisting Engine

Owing to change from steam to electrical equipment, Nordberg first motion, double conical drum, duplex steam hoisting engine, Corliss gear, cylinder 18 x 42. Drum capacity grooved for four thousand feet of 1¼-in. rope.

TENNESSEE COPPER COMPANY
61 Broadway, New York

CRUSHING ROLLS

We have the following sets of latest type Crushing Rolls in Denver stock, ready for immediate shipment. All have been thoroughly overhauled and are in first-class condition in every respect.

2 sets 16 x 36 Colo. Iron Works.
9 sets 16 x 36 Davis Iron Works.
5 sets 14 x 36 Allis Reliance outboard bearing.
7 sets 14 x 30 Allis Reliance outboard bearing.
2 sets 14 x 27 H. & B. Parallel.
2 sets 14 x 27 Davis Iron Works.
3 sets 12 x 20 Davis Iron Works.
1 set 12 x 20 H. & B. Parallel.
1 set 12 x 12 Davis Sampling.

THE MORSE BROS. MACHINERY AND SUPPLY COMPANY, Denver, Colo.

Tube Mill Bargain

4 x 20 ft. tube mill, brand new, complete, weight 16 tons, f.o.b. cars, **$1500.**

SOUTHWESTERN WRECKING CO.
El Paso, Texas.

Hollow Drill Steel For Sale

4 tons 1¼-in. Round, 4 tons 1¼-in. Hexagon Jakos Swedish Bars for immediate shipment from our New York warehouse.

HAMILTON & HANSELL
17 Battery Place, New York City

STEAM HOISTS

1—New 14 x 16 Vulcan single drum geared hoist. Immediate shipment at a special price.
1—Double reel, first motion, Corliss hoist, 28 x 72 in. cylinders. Load 15 tons. Speed 2000 ft. per minute. Offered at 25% of present cost.

The Hendrie & Bolthoff Mfg. & Supply Co.
Denver, Colorado.

COMPLETE STAMP MILL

30 stamps 1050 lb. Denver Engineering Works, latest type, chrome steel shoes and dies, complete with all timbers, feeders, etc., used three months, perfect condition.

SOUTHWESTERN WRECKING COMPANY
El Paso, Texas

Additional Advertisements of
Second-Hand Equipment
For Sale
See Following Pages

SEARCHLIGHT SECTION

Second Hand Equipment

SINGLE DRUM HOISTS—Electric Driven

2 Lidgerwood single drum mine hoists, drums 30-in. dia. x 24-in. face x 4-in. flanges, gear ratio 18:126, geared to Westinghouse type 10-K motors, series wound, with R-32 controllers and grid resistances. One motor 220 volts, 525 R.P.M., other 550 volts, 878 R.P.M.

3 Lidgerwood single drum mine hoists, drums 30-in. dia. x 24-in. face x 4-in. flanges, direct geared to General Electric motors, type IQC, form M, 2 ph., 60 cy., 220 volts, slip ring, 830 R.P.M., complete with T-10 controller.

5 Lidgerwood single drum mine hoists, drums 30-in. dia. x 24-in. face x 4-in. flanges, direct geared to Westinghouse motors, type 10-K, series wound, 52 H.P., 220 volts, direct current, 700 R.P.M., complete with R-32 controllers and grid resistances.

ALTERNATING CURRENT MOTOTS—25 Cycle

No.	H P.	Manufacturer	Type or Form	Phase	Voltage	Speed
1	½	Fairbanks-Morse	B	3	440	1500
3	1	General Electric	KT-C	3	440	750
1	2	General Electric	K	3	440	1800
5	2	General Electric	KT-C	3	440	750
1	5	General Electric	KT-C	3	440	750
13	5	Allis-Chalmers	AN	3	440	720
1	7½	General Electric	KT-C	3	440	1500
3	7½	General Electric	K	3	440	750
1	7½	Westinghouse	CCL	3	220	710
1	10	General Electric	MIC	3	110	1500
1	10	General Electric	K	3	440	750
1	10	Westinghouse	C	3	400	750
1	10	Allis-Chalmers	.....	3	220	720
1	10	Westinghouse	CCL	3	440	710
2	10	Westinghouse	HF	3	440	710
3	15	Allis-Chalmers	AN	3	440	720
1	15	Westinghouse	CCL	3	440	720
1	20	Allis-Chalmers	.....	3	440	720
1	25	General Electric	K	3	220	750
1	30	Fairbanks-Morse	.....	3	440	1500
1	30	Westinghouse	C	3	400	750
3	30	Westinghouse	CCL	3	440	720
1	30	Allis-Chalmers	AN	3	440	720
1	30	Allis-Chalmers	.....	3	440	480
1	35	Burke	.....	2	220	750
1	35	Geneal Electric	L	3	440	750
1	35	Allis-Chalmers	.....	3	440	720
2	37	General Electric	ITC-M	3	440	750
1	40	Westinghouse	CCL	2	440	720
1	40	Westinghouse	CCL	3	440	720
1	40	Westinghouse	CCL	3	440	715
1	50	Allis-Chalmers	AN	3	440	1450
1	50	Allis-Chalmers	.....	3	440	720
1	50	Westinghouse	CCL	3	440	715
1	50	Westhinghouse	C	3	400	500
2	50	General Electric	MI	3	440	500
3	50	Allis-Chalmers	.....	3	440	480
1	60	General Electric	.....	3	440	500
1	75	Triumph	.....	3	440	720
1	75	General Electric	MI	3	220	500
1	75	General Electric	ITC-5015	3	2200	500
1	75	General Electric (Slip Ring)	...T..	3	2200	500
1	75	General Electric (Slip Ring)	ITC-M	3	440	475
1	100	General Electric	K	3	208	500
1	100	Westinghouse	C	3	2000	480
1	100	Allis-Chalmers	.....	3	440	480
1	150	General Electric	K	3	2080	500
1	150	Allis-Chalmers	.....	3	440	490
1	200	Eestinghouse	C	3	400	375
1	300	Allis-Chalmers (Slip Ring)	.....	3	2200	500
2	450	Westinghouse	CCL	3	440	360
1	500	Allis-Chalmers (Slip Ring)	.....	3	440	360
1	1250	General Electric	M	3	2080	365

AIR COMPRESSORS—Belted

1 Ingersoll-Sargent, 12 x 18 x 12 in., duplex, class JC, cross compound, 550 cu.ft. air per min., 100 lb. pressure, 165 R.P.M., belt wheel 75 x 19 in. face.
1 Ingersoll-Rand, 12½ x 12 in., class E straight line, 230 cu.ft. air per min., 100 lbs. pressure, wheel 66 in. diam.
1 Hall, 13 x 7½ x 9 in. cross compound, class K, 2 stage duplex, 182 cu.ft. air per min. at 135 R.P.M.
1 Franklin 9 x 11 in., type CSB, 130 cu.ft. air per min. at 160 R.P.M., two wheels, 46 in. dia. x 6 in. face.
1 Ingersoll-Rand, 9 x 14 in., pulley 47½ in. diam.
1 Ingersoll-Rand Imperial 7 x 9 in., type XI, 76 cu.ft. at 190 R.P.M., 100 lbs. pressure, wheel 42 in. dia. x 7½ in. face.
1 Clayton vertical, 3½ x 3½ in., 8.8 cu.ft. air per min. at 450 R.P.M.
1 Franklin (Chicago Pneumatic Tool Co.), 23 x 14 x 18 in., with intercooler, belt wheel 9 ft. dia. x 30 in. face.
1 Ingersoll-Rand, 16½ x 25½ x 16 in., class J, compound, with intercooler and unloader, wheel 7 ft. dia. x 30 in. face.

Steam Driven

1 Laidlaw-Dunn-Gordon, 16 x 18 x 11 x 14 in., compound, 800 cu.ft. air per min., 100 lbs., 85 R.P.M.
1 Ingersoll-Sargent, 10 x 12½ x 12 in., class A, piston inlet type, 360 cu.ft. air per min.
1 Chicago Penumatic Tool Co., 9 x 9 x 11 in., class G-SS, straight line, single stage, 130 cu.ft. air per min., 100 lbs. pressure, 160 R.P.M.
1 Ingersoll-Rand, 6 x 10 x 6 in., type NF-1, 114 cu.ft. air per min.

Electric Drive

1 Laidlaw-Dunn-Gordon, 25 x 15 x 18 in., 2 stage, requires 300 H.P. motor.
1 National Brake & Elec. Co., type 3 VS-23, 300 cu.ft. air per min., complete with 50 H.P. motor, 3 ph., 60 cy., 220 volts, direct connected.
1 Christianson, type D-4, 50 cu.ft. air per min. with 10 H.P. motor, 550 volts, d.c., 1100 R.P.M.

MAC GOVERN & COMPANY, INC., 114 Liberty Street, New York, N. Y.

For Sale

Crushers Tube Mills
Rolls Ball Mills
Concentrating Tables
Hoists Rails and Pipe
Ore Buckets and Cars
Steam and Gas Engines
Dryers Roasters
Pumps Wire Rope

Complete Lines.

BOGUE SUPPLY CO.
210 Felt Building,
Salt Lake City, Utah

JAW CRUSHERS

The following are in Denver stock for immediate shipment. All fitted with manganese Jaw Plates and in first-class condition.

1—15 x 24 Allis-Chalmers Blake.
1—13 x 24 Allis-Chalmers Blake.
1—13 x 24 McFarlane Blake.
1—13 x 24 Farrell Foundry Blake.
1—30 x 5 Robinson-Rea Co. Blake.
2—10 x 20 Davis Iron Works Blake.
2— 9 x 15 Davis Iron Works Blake.
3— 7 x 10 Standard Blake.
1— 9 x 15 Davis Iron Works Dodge
2— 7 x 10 Gates Iron Works Dodge.
1— 7 x 10 Denver Roll Jaw.
1— 7 x 16 Samson.

The Morse Bros. Machinery & Supply Co.
Denver, Colo.

FOR SALE

1—One-yd., Atlantic **Steam Shovel** (Am. Locomotive Works)
1—Eighteen ton **Locomotive** (Davenport Locomotive Works)
1—Four-ton **Locomotive**
1—Keystone **Drill Machine**, Traction, No. 3, Friction Hoist for 350 ft.
9—Side dump, 3 Yd., Narrow Gage **Waste Cars**

Wasp No. 2 Mining Co., Deadwood, S. D.

FOR SALE
12,000 ft. 10-in. Class C and D bell and spigot

Cast Iron Water Pipe

Practically new. *Immediate shipment.*
COATES, BENNETT & REIDENBACH, Inc.
Rochester, N. Y.

Portland Filters, New

2—12 x 10 ft. at a sacrifice. These have never been set up. Now in Denver.

SOUTHWESTERN WRECKING CO.
El Paso, Texas.

FOR SALE
Four De La Vergne, Hornsby & Akroyd

Oil Engines

25 Horse Power Each. First-Class Condition.
Empire Smelting & Refining Co.
Mills Building, P. O. Box 443, El Paso, Tex.

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40 H. P. FAIRBANKS-MORSE GAS HOIST

Single drum, direct connected, geared, complete with 750 ft. new ⅝-in. rope, absolutely perfect, immediate delivery.

Southwestern Wrecking Co., El Paso, Texas

FOR SALE—2 tons Solid Octagonal
DRILL STEEL
1 1/16 to 1 5/16. Also several 2½ and 3 in. Piston
AIR DRILLS
with spare parts. *Write for details.*
Cleveland Mining Co., Dubuque, Iowa

ELIMINATE THE FINES
From Your Crusher Feed

THE SHERIDAN SHAKING GRIZZLY will

handle lumps up to 25-in. cubes and remove the fines, even though your ore be of a clayey, talcy or earthy nature.

Sheridan Shaking Grizzly feeding the crusher at The Timber Butte Mill, Butte, Mont.

THE SHERIDAN SHAKING GRIZZLY will

successfully remove the fines with a feed of ten (10) tons per sq. ft. of screening surface having 1½ in. to 2 in. apertures.

It Reduces Your Horse Power

Write for Circular.

TRAYLOR ENGINEERING & MFG. COMPANY

Main Office and Works:
ALLENTOWN, PA., U. S. A.

New York Office: 26 Church Street **Chicago Office: 1414 Fisher Bldg.** **Western Office: Salt Lake City, Utah**

Better Roasting

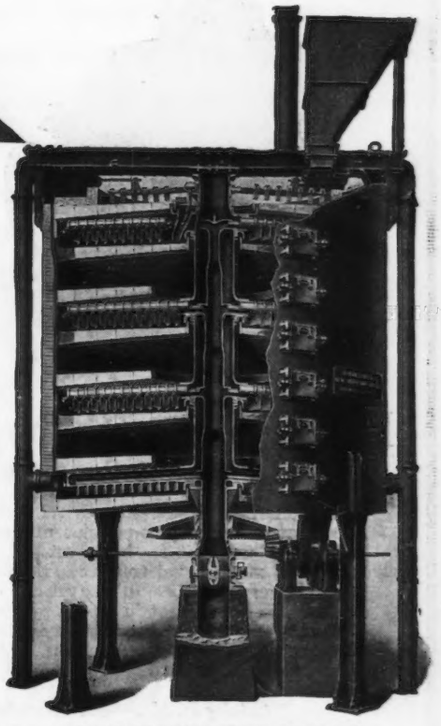
depends on perfect temperature control more than aught else. To get the best results the proper temperature must be reached and maintained.

The New Herreshoff Temperature Controlled and Air-Cooled Furnace
PATENTED

is superior to anything on the market in this respect. The temperature can be run up just as high as is needed to produce a perfect roast and then kept at that point. Because of the perfect temperature control there is no danger of fusion.

Remember also that the New Herreshoff uses air for the cooling medium instead of water.

Consult our Engineering Department about your ore roasting. No obligations incurred.



GENERAL CHEMICAL COMPANY
Herreshoff Furnace Department
25 Broad Street, New York, N. Y.

PACIFIC FOUNDRY COMPANY
18th and Harrison Streets San Francisco California
Pacific Coast Agents

What a busy summer you'll have with the CEMENT-GUN

Consider the length of time it will take you to protect your mine timbers from fungus, bad water and rot—

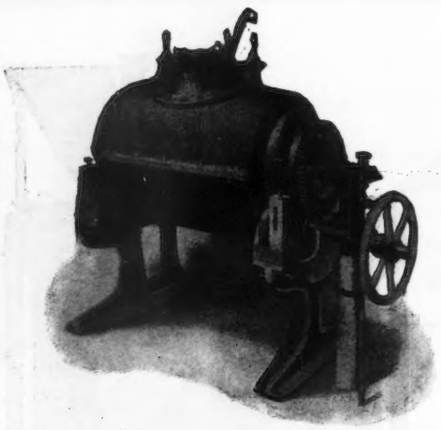
And to waterproof your tunnels, ditches, flumes, etc.

And to fireproof your mill buildings—

And to repair the concrete work that has cracked, crumbled or split.

Yes, you'll find it very easy to keep a Cement-Gun continually busy right through the summer. It can do most of the light cement work and reduce your costs in doing it—it can put Gunite where concrete could never be employed before. At a small cost it can reduce your fire risk, weather risk and add materially to the permanent value of your property. Booklet?

CEMENT-GUN COMPANY, Incorporated
South 10th and Mill Streets, Allentown, Penna.
Cement-Gun Company, Inc., 30 Church St., New York City.
E. R. Ayers, 1414 Fisher Building, Chicago, Ill.
John A. Traylor, Newhouse Building, Salt Lake City, Utah.
Taylor Engineering Co., 538 Central Bldg., Seattle, Wash.
Taylor Engineering Co., Vancouver, B. C.
A. R. Roberts, 727 Traders Bank Bldg, Toronto, Ont., Can



For Bullion Ores Metals and Cyanide

Large Output with the Simplex without Crucible

The Monarch Simplex Non-Crucible Bullion Furnace shown here is very popular and many leading plants are using it in batteries. It produces a quality of metal equal to that melted in crucibles, but in larger quantities, in less time. Easy to start—easily lined and kept in repair. Uses oil, or gas and air. We manufacture many other types of furnaces you should know about. **Ask for our literature and prices.**

Catalog E. M. J—For all metals.

The Monarch Engineering & Mfg. Co.
1206 American Bldg. **Baltimore, Md., U. S. A.**

The Proof of the Pudding is in the—After Taste

AETNA

Low-Freezing Standard Dynamites
(Low-Freezing Ammonia)

leave that pleasant "after taste" with you when used for your Blasting. They leave it with your pocket-book, too, by reason of their low cost, their great disruptive power and by the elimination of unnecessary thawing in cold temperatures.

Many of the largest consumers are now most satisfactorily using Aetna Low-Freezing Standard Dynamites (Low-Freezing Ammonia) in place of the more expensive Nitro-Glycerin and Gelatin Dynamites heretofore employed. You have an equal chance to make this gain.

Write to us direct, or to our nearest Branch Office, and let us give you more details of the advantages and saving in cost to be gained by using Aetna Low-Freezing Standard Dynamites.

GEORGE C. HOLT AND BENJAMIN B. ODELL
Receivers of
AETNA EXPLOSIVES COMPANY
Incorporated
120 Broadway **New York**

The Margin of Certainty

Like a factor of safety is the liberal margin of quality that is built into all

Weston

Indicating Instruments

Each instrument, in its accuracy, its overload capacity, etc., is capable of service far in excess of any demands that can be foreseen in the field for which it is designed.

As a result, the unfailing reliability of Weston Instruments has earned the implicit confidence of their users.

Model 310 Single Phase and D.C. Wattmeter

Weston Electrical Instrument Co.
17 Weston Ave.
Newark, N. J.

23 Branch Offices in the Larger Cities

Write for particulars regarding Weston Models designed for any field of Indicating Electrical Measurement that interests you.

The Knox Coupling
Abolishes leaks in air hose. A big improvement over the types. Prevents wear.

The Knox Throttle Valve
Insures efficient control of your mining machines, drills, etc.

Send for illustrated Catalog.

Knox Mfg. Co. - 821 Cherry St., Phila., Pa.

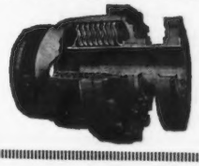
STEAM TRAP SARCO

will not freeze or clog. Perfect for exposed positions and for high and low pressure.

Write us for free trial.

Sarco Company, Inc.
231 Broadway, N. Y. City

STEEL EXPANSION JOINTS



The test of time proves the chrome vanadium steel construction used.

Good for steam or hot water up to 200 pounds.

Alberger Pump & Condenser Co.
140 Cedar Street, New York City

Chicago St. Louis Philadelphia Boston 4

JAMES CONCENTRATING MACHINERY

Jigs, Screens, Sand and Slime Tables, Classifiers, Automatic Ore Feeders, etc.

Manufactured by
JAMES ORE CONCENTRATOR CO.
35 Runyon Street, Newark, N. J.

Of Interest to Mine Superintendents

Superla Oils

assure you the highest degree of lubrication.

Their adoption by leading industrial works of the world is proof of their power-saving qualities.

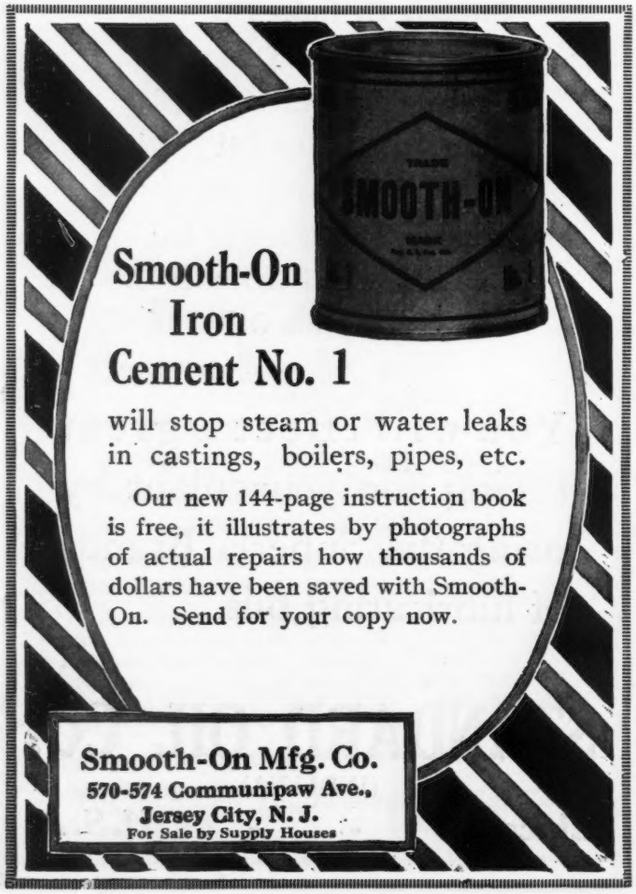
A Superla Brand for Every Use

Superla Cylinder Oil
Superla Engine Oil
Superla Dynamo Oil
Superla Turbine Oil
Superla Machine Oil
Superla Transformer Oil
Superla Diesel Cylinder Oil
Superla Soluble Oil

You will effect a great saving for your plant by using the Superla Brands of lubricating oils.

STANDARD OIL CO.
(INDIANA)

Chicago - - U. S. A.


SMOOTH-ON
Smooth-On Iron Cement No. 1
will stop steam or water leaks in castings, boilers, pipes, etc.
Our new 144-page instruction book is free, it illustrates by photographs of actual repairs how thousands of dollars have been saved with Smooth-On. Send for your copy now.
Smooth-On Mfg. Co.
570-574 Communipaw Ave.,
Jersey City, N. J.
For Sale by Supply Houses

Dixon's Waterproof Graphite Grease

is a heavy, mineral grease with the proper content of Dixon's Flake Graphite. It has a consistency suited to heavy service at slow speeds under heavy pressure. It adheres to metal surfaces and is unaffected by water.

Write for Booklet 42-W.

Made in JERSEY CITY, N. J., by the

Joseph Dixon Crucible Company

D X N TRADE MARK Established 1827 D X N TRADE MARK

GARLOCK PACKINGS

are Specially Adapted to the Severe Service of MINING MACHINERY.

Write for Catalog.

THE GARLOCK PACKING CO., Palmyra, N.Y.

Branches in Principal Cities

WATER SOFTENING OR FILTRATION

FOR BOILER FEED AND ALL INDUSTRIAL USES

Wm B. SCAIFE & SONS CO., PITTSBURGH, PA.

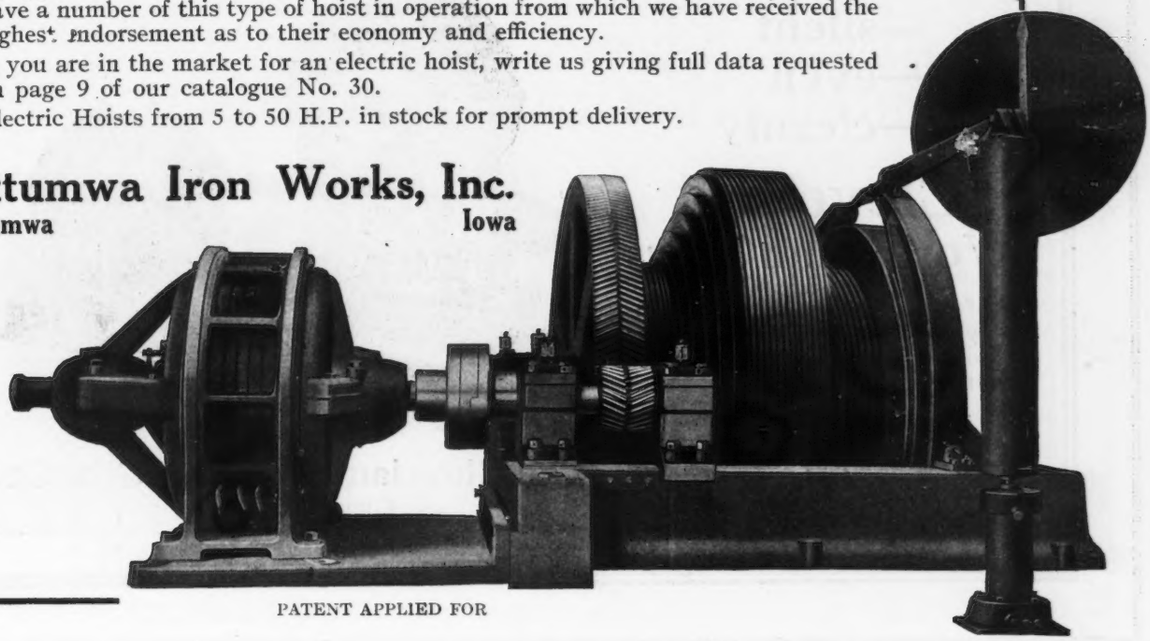
OTTUMWA High Efficiency Electric Hoists

You can reduce your power cost by this design of Electric Hoist. It also reduces first cost by making possible a smaller motor, consequently reducing the maximum demand charge. The brake is operated by oil under pressure, and is equipped with overwinding device, and automatic emergency application. We have a number of this type of hoist in operation from which we have received the highest endorsement as to their economy and efficiency.

If you are in the market for an electric hoist, write us giving full data requested on page 9 of our catalogue No. 30.

Electric Hoists from 5 to 50 H.P. in stock for prompt delivery.

Ottumwa Iron Works, Inc.
Ottumwa **Iowa**



PATENT APPLIED FOR

Single Friction Drum Gasoline Hoist

A Hoist of the type here illustrated is not only frequently found necessary but very desirable, because of the low cost of operation and up-keep.

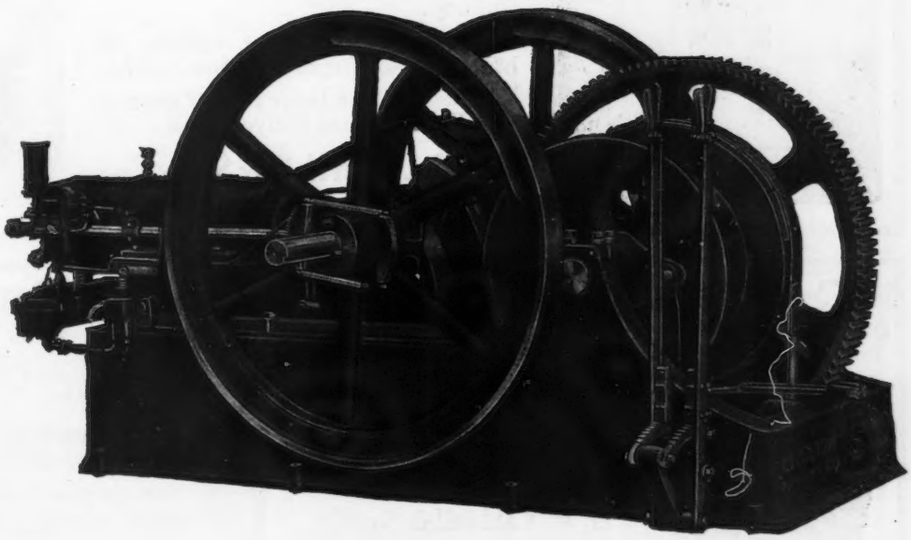
Our Single Friction Drum Geared Hoist driven by Gasoline, Kerosene, Distillate or Crude Oil Engine is quite as reliable in operation as a Steam or Electric Hoist.

These Hoists are fully self-contained and designed throughout for severe and constant service.

The Gears are accurately cut from solid metal on automatic machines. Gear Guards (not illustrated) of heavy steel bands are furnished.

We build these hoists of the type shown from 8 H.P. to 40 H.P., inclusive.

Our large output enables us to make very prompt shipments.



The English Iron Works Company, Kansas City, Mo., U. S. A.

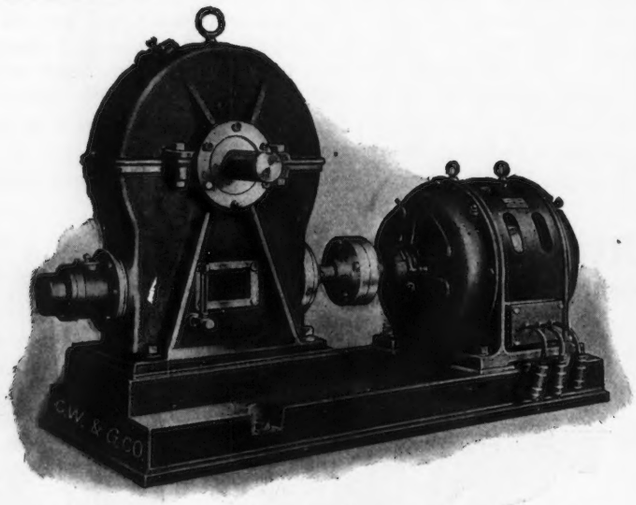
Wherever Transmission must be—

—silent
—even
—cleanly

Cleveland Worms and Gears

are found. All worms are accurately ground on the threads, after hardening to correct distortion of the steel heat treatment.

We also mount both the worm and gear on ball bearings—worm having radial bearings at each end of the shaft and a heavy, double-acting thrust bearing.



The Cleveland Worm & Gear Co.
Cleveland, Ohio
Agencies: C. E. Quicke, 315 Euston Road, London, England. The Industrial Equipment Co., San Francisco., Cal.

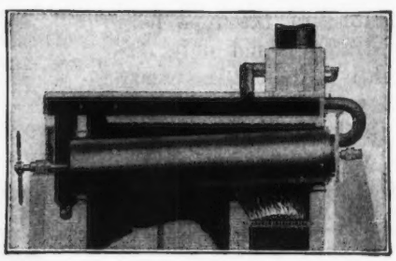
Our Business is to REDUCE YOUR HANDLING COSTS

Our Automatic Skip Hoists reduce the cost of handling materials to a minimum.

Our Conveying and Elevating Machinery has a minimum cost for upkeep.

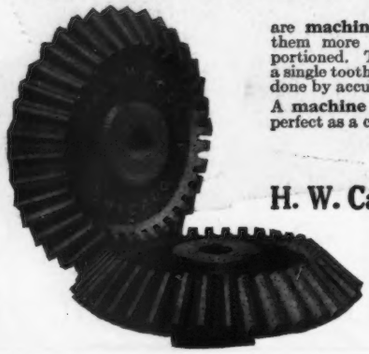
We make the largest variety of Mechanical Dryers in the world.

We also make a large line of crushers, Feeders and Pulverizers.



The C. O. Bartlett & Snow Co.
CLEVELAND, OHIO 50 Church St., New York

CALDWELL GEARS



are **machine molded**, which makes them more uniform and better proportioned. The teeth are molded from a single tooth pattern, the spacing being done by accurate machinery.

A **machine moulded** gear is as near perfect as a cast iron gear can be made.

H. W. Caldwell & Son Co.
CHICAGO — 17th St. and Western Ave.
New York—50 Church St.
Dallas—711 Main St.

Wuest Herringbone Gears

Make 20 to 1 Reductions Possible

Herringbone Construction and the Wuest Patent make wonderful single reductions possible. Let us tell you all about it in our descriptive matter.

Write
The Falk Company, Milwaukee, Wisconsin

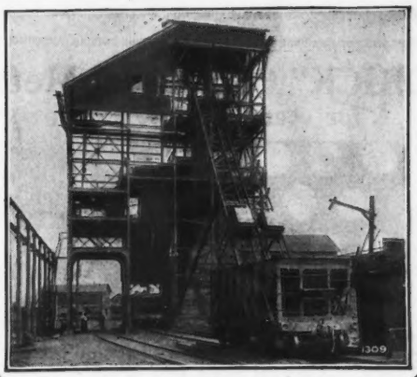
ROBT. HOLMES & BROTHERS, Inc., Successors to
Danville Foundry & Machine Co., DANVILLE, ILLINOIS.

The consolidation of these two large plants means the manufacture of a more varied and extensive line of mining and other machinery, doubling the facilities of the works.

AMERICAN BRIDGE COMPANY

HUDSON TERMINAL-30 CHURCH STREET, NEW YORK

Manufacturers of Steel Structures of all classes particularly BRIDGES AND BUILDINGS



Ore Crusher Plant, Ishpeming, Mich.

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Buffalo, N. Y. . Marine National Bank
Cincinnati, Ohio. Union Trust Building
Atlanta, Ga. . . . Candler Building
Cleveland, Ohio . . Guardian Building
Detroit, Mich., Beecher Ave. & M. C. R. R.
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Denver, Colo., First Nat'l Bank Building
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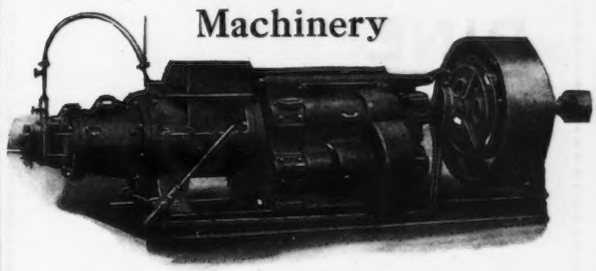

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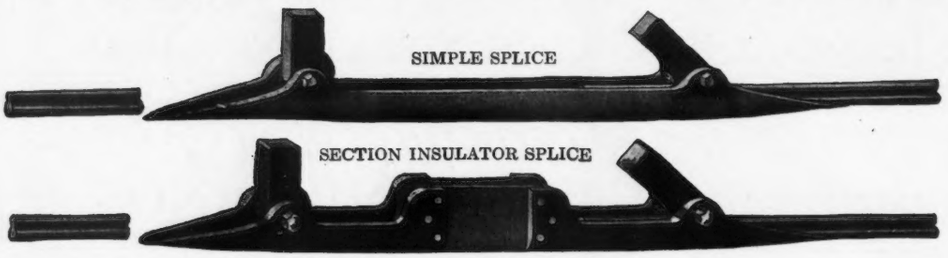

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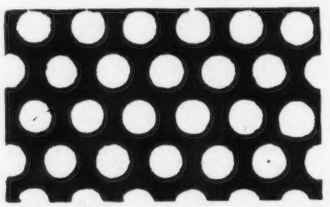

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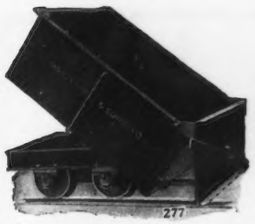

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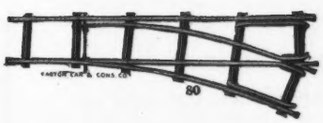

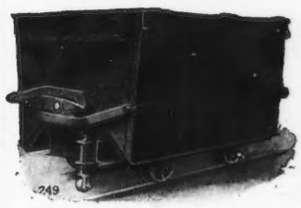

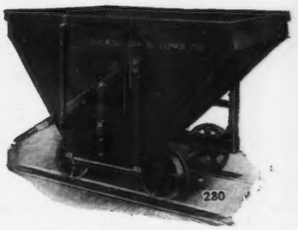

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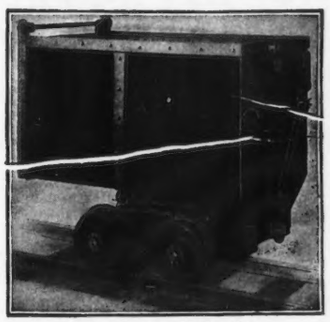
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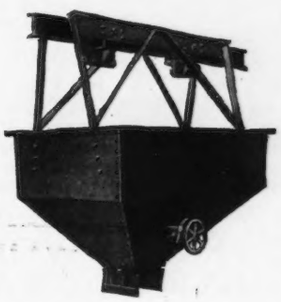

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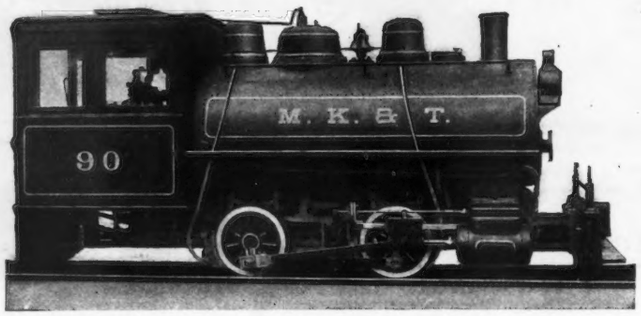

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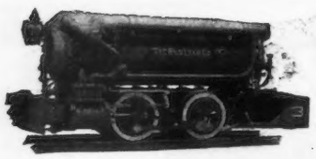

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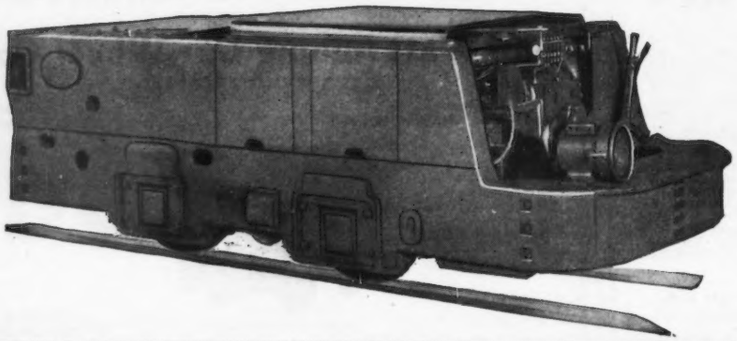

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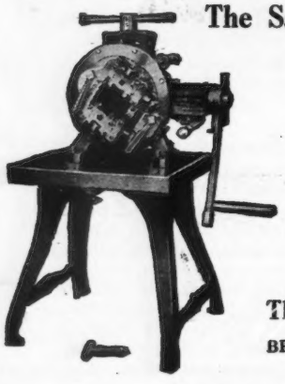

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Balances
Ainsworth & Sons, Wm., Denver, Colo.
Denver Fire Clay Co., Denver, Colo., U. S. A. Analytical, assay, button balances, made by Keller, Ainsworth, Troemner, Thompson, Oertling, Voland, Becker, Sartorius and Kern.
Mine & Smelter Supply Co., The, Denver, Colo. Branches: Salt Lake City, El Paso, New York.
Thompson Balance Co., Denver, Colo.
Troemner, Henry, 911 Arch St., Phila., Pa.

Belt Dressing
Black Diamond Mfg. Co., Cincinnati, Ohio. Belt dressing for dusty, dry, wet or oily leather, rubber and cotton belts.

Belting, Conveyor
Boston Belting Co., Boston, Mass.
Dick, Ltd., R. & J., Passaic, N. J.
Gandy Belting Co., Baltimore, Md.
Goodrich Co., The B. F., Akron, Ohio. Rubber for hardest service. "Longlife" and "Maxecon" grades for continuous operation and maximum life.
Imperial Belting Co. General Office and Factory: Lincoln and Kinzie St., Chicago, Ill. Sales Offices: 42 Broadway, New York; 423 Yeon Bldg., Portland, Ore.; 525 Market St., San Francisco, Calif. "Sahara" & "Rexall" brands.
Robins Conveying Belt Co., New York.

Belting, Elevator
Dick, Ltd., R. & J., Passaic, N. J.
Goodrich Co., The B. F., Akron, Ohio. Special rubber elevator belts.
Imperial Belting Co. General Office and Factory: Lincoln and Kinzie St., Chicago, Ill. Sales Offices: 42 Broadway, New York; 423 Yeon Bldg., Portland, Ore.; 525 Market St., San Francisco, Calif. "Sahara" & "Rexall" brands.

Belting, Transmission
Dick, Ltd., R. & J., Passaic, N. J. "Dick belt, the waterproof belt."
Gandy Belting Co., Baltimore, Md.
Goodrich Co., The B. F., Akron, Ohio. Rubber belts for drives. Friction surface and rubber covered.
Graton & Knight Mfg. Co., Worcester, Mass. "Spartan," water, steam, oil and heat resisting.
Imperial Belting Co. General Office and Factory: Lincoln and Kinzie St., Chicago, Ill. Sales Offices: 42 Broadway, New York; 423 Yeon Bldg., Portland, Ore.; 525 Market St., San Francisco, Calif. "Sandow" belting.
Schieren Co., Charles A., New York City. "Duxbak." Moisture-resisting leather.

Bit Sharpeners
Mayer Bros. Co., Mankato, Minn. "Little Giant" combination pick point and chisel bit dies and "Little Giant" pcik point dies.

Blasting Supplies
Aetna Explosives Co., 2 Rector St., New York.

Blowers
Connersville Blower Co., The, Connersville, Ind. Rotary positive type. Two impellers, balanced at all speeds.
General Electric Co., Schenectady, N. Y.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
Morse Bros. Mach. & Supply Co., Denver, Colo.
Roots Co., P. H. & F. M., Connersville, Ind. Low-pressure sizes to 42,105 cu.ft. per min. High-pressure up to 10 lb. Rotary positive pressure.

Blowers, Centrifugal
Ingersoll-Rand Co., 11 Broadway, New York. Turbo-blowers for blast and converter work. All pressures and volumes.

Boilers
Abendroth & Root Mfg. Co., 45 Bway., New York.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
Mine & Smelter Supply Co., The, Denver, Colo. Branches: Salt Lake City, El Paso, New York.
Moore & Co., C. C., Engineers, San Francisco, Cal.
Morse Bros. Mach. & Supply Co., Denver, Colo.

Boiler Tubes
National Tube Co., Pittsburgh, Penn.

Boilers, Locomotive
American Locomotive Co., 30 Church St., N. Y.

Books, Technical
McGraw-Hill Book Co., Inc., 239 W. 39th St., New York. Branches: London and Berlin.

Boots and Shoes
Goodrich Co., The B. F., Akron, Ohio. White rubber mining boots and shoes. (Red line around top.)

Brick, Fire
Harbison-Walker Refractories Co., Pittsburgh, Pa.

Bridges, Ore Handling
American Bridge Co., 30 Church St., New York.

Bridges, Suspension
Roebling's Sons Co., John A., Trenton, N. J.

Briquetting Machinery
General Briquetting Co., 25 Broad St., N. Y.

Buckets, Elevator
Hendrick Mfg. Co., Carbondale, Penn.

Buckets, Orange Peel and Clam Shell
Industrial Works, Bay City, Mich. Designed for quick attachment or removal.

Buckets, Ore
Watt Mining Car Wheel Co., Barnesville, Ohio.

Buildings, Steel Frame
Stupp Bros. Bridge & Iron Co., St. Louis, Mo.

Cables, Insulated Telephone
Stromberg-Carlson Telephone Mfg. Co., Rochester, N. Y.

Cableways
Flory Mfg. Co., S., Bangor, Penn.
Roebling's Sons Co., John A., Trenton, N. J.

Cages, Hoisting
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
Ottumwa Iron Works, Ottumwa, Iowa.
Traylor Engineering & Mfg. Co., Allentown, Penn.

Candles
Standard Oil Co., Chicago, Ill.

Carbons and Bortz
Byron & Hall, 116 Broad St., New York.
Diamond Drill Carbon Co., World Bldg., Park Row, New York, N. Y.
Levine, Abr., 35 Nassau St., New York.

Cars, Gable Bottom
Easton Car & Construction Co., Easton, Pa.

Cars, Hopper
Easton Car & Construction Co., Easton, Penn.

Cars, Ore
Allis-Chalmers Co., Milwaukee, Wis.
Atlas Car & Mfg. Co., Cleveland, Ohio.
Easton Car & Construction Co., Easton, Penn.
Sanford-Day Iron Co., Knoxville, Tenn.
Watt Mining Car Wheel Co., Barnesville, Ohio. Capacity 8 to 25 cu.ft. Any gage. Steel; end or side dump
Traylor Engineering & Mfg. Co., Allentown, Penn.

Cars, Quarry
Easton Car & Construction Co., Easton, Penn.
Traylor Engineering & Mfg. Co., Allentown, Penn.

Cement, Iron
Smooth-On Mfg. Co., Jersey City, N. J. In 1-, 51, 10- and 25-lb. cans. "Smooth-On" iron cements, metallize, and become part of metal to which applied.

Castings
Pacific Foundry Co., San Francisco, Cal.

Cement-Placers, Jet
Cement-Gun Co., Inc., Allentown, Penn. Cable: Cementgun. Branches: New York, Pittsburgh, Chicago, San Francisco. Three sizes. Capacities variable according to number of nozzles, hose, sizes and air pressures. The "Cement-Gun" is a portable apparatus for depositing cement or "Gunite" coatings by air pressure for covering old and new structures, building new ones and grouting or filling cracks. See advertisement.

Chains, Transmission
Morse Chain Co., Ithaca, N. Y. For drives up to 5,000 hp. Reduction ratios to 7 and 8 to 1. "Rocker-Joint" to reduce wear; quiet, positive.

Chemical Apparatus
Heil Chemical Co., Henry, St. Louis, Mo.
Mine & Smelter Supply Co., The, Denver, Colo. Branches: Salt Lake City, El Paso, New York.

Chemicals
General Chemical Co., 25 Broad St., New York.
Grasselli Chemical Co., The, Cleveland, Ohio.
Roessler & Hasslacher Chemical Co., New York.

Circuit Breakers, Electric
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Classifiers
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Colorado Iron Works Co., Denver, Colo., U. S. A. "Akins" spiral revolving in inclined trough.
Deister Machine Co., Ft. Wayne, Ind., U. S. A.; No. 1 London Wall Bldgs., London Wall, E. C. Capacity on 60-mesh, 20 tons per 24 hr. Cast-iron barrel containing staggered inverted hollow-slotted cones, acting as baffles. Incoming water takes fines to top, coarse material sinking. Send for Bulletin No. 5.
Denver Engineering Works Co., Denver, Colo. "Richards" pulsator for table feed; "Ovoca" for sand slime separation.
Dorr Co., Denver, Colo.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
James Ore Concentrator Co., Newark, N. J.
Mine & Smelter Supply Co., The, Denver, Colo. Branches: Salt Lake City, El Paso, New York.
Traylor Engineering & Mfg. Co., Allentown, Penn.

Clutches, Friction
Caldwell Co., W. E., 2170 Brook St., Louisville, Ky.

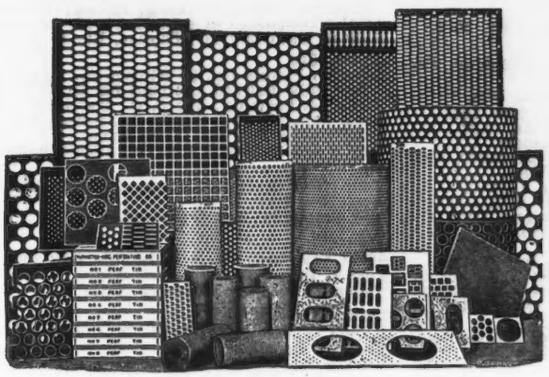
Cocks
National Tube Co., Pittsburgh, Penn.

Compressors, Air
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Bury Compressor Co., Erie, Penn.
Chicago Pneumatic Tool Co., Chicago, Ill. Fuel oil, gas, steam power driven.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
Ingersoll-Rand Co., 11 Broadway, New York. Branches: Boston, Birmingham, Butte, Cleveland, Chicago, Denver, Duluth, El Paso, Knoxville, Los Angeles, Phila., Pittsburgh, St. Louis, Seattle, Salt Lake City, New Orleans, Scranton, Juneau. "Imperial," "Ingersoll-Rogler," "Turbo"—all sizes, pressures, types. Stationary and portable.
Laidlaw Works, 115 Broadway, New York.
Moore & Co., C. C., Engineers, San Francisco, Cal.
Morse Bros. Mach. & Supply Co., Denver, Colo.
Nordberg Mfg. Co., Milwaukee, Wis.
Norwalk Iron Works Co., So. Norwalk, Conn. Size to suit work.
Sullivan Machinery Co., Chicago, Ill., U. S. A. Steam and power drive. Tandem compound Corliss, angle compound, belt or motor drive, portable, underground motor driven.

Compressors, Garage
Laidlaw Works, 115 Broadway, New York.

Compressors, Gas
Laidlaw Works, 115 Broadway, New York.

Concentrators, Table
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Butchart, W. A., 603-05-07 Mercantile Bldg., Denver, Colo. One model in two sizes: 6'x16' and 3'x8'. Capacities 5 to 150 tons per 24 hr., according to class and mesh of feed. Two-mineral separations. Structural steel and cast-iron base and mount-



All Sorts of Screens

For sizing Ores, Coal, Clay, Cement, Crushed and Ground Minerals and other products.

Punched Steel Plates and Sheets for Trommels, Stamp Mills, Grizzlies, Jigs, Chilean and Huntington Mills, Crushers and all fixed or movable screens.

Standard Sizes of Holes varying in diameters by millimeters and fractions of an inch in any thickness of metal from No. 30 U.S.S. Gauge Sheets to one-inch Steel Plates.

Cylindrical screen sections and segments for revolving screens with Round, Oblong or Square Holes, either lap joint or butted and fastened with clips, bolted or riveted.

We want you to know that **"Harrington & King Screens"** are dependable, uniform in size, quality and perfection of finish.

They do just what all good screens should do and more than is expected of them, rather than less.

Tell us your requirements in detail, and don't put it off! Anticipate your wants, for the Screens all have to be made to order.

The Harrington & King Perforating Co.

No. 620 North Union Avenue
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New York Office, 114 Liberty Street

"BULLDOG" ROCK DRILL STEEL

Hollow **Solid**

The Pioneer of Hollow Drill Steel

Trade Mark

Unbeaten and Unbeatable

Saves Time and Money

Reg. U. S. Pat. Off.

Holds All Records

International High Speed Steel Co.

Works: Rockaway, N. J. **99 Nassau St., New York**

REPRESENTATIVES:

LAKE SUPERIOR DISTRICT—W. G. Phillips, Calumet, Mich.
PACIFIC COAST—H. D. Staley, 132 Lick Building, San Francisco, Calif.
SALT LAKE CITY—F. C. Richmond Machinery Co.
ONTARIO, CANADA—H. L. Usborne, Cobalt, Ont.
MONTREAL—Ralph B. Norton, Agent, 126 Craig Street, West
BRITISH COLUMBIA—E. G. Prior & Co., Victoria, B. C.

ing regular equipment. Built to order without base for mounting on concrete piers. Line shaft or individual motor drive.
Reinforced steel deck; linoleum or cement top. Reciprotor-type head motion, water and dust-proof, completely self-oiling.
Deister Concentrator Co., The, Ft. Wayne, Ind.
Prices on application.
Deister No. 3 slimer for fines and slimes in either single- or double-deck type; Deister No. 4 for sands either roughing or finishing, classified or unclassified, in single-deck type only, Deister No. 5 for coarse and fine classified sands in either single- or double-deck type. Overstrom table for fine and coarse feeds has large capacity for roughing or finishing in either single- or double-deck type. Head motion and under construction for all tables designed to reduce upkeep and operating costs. Table makes more than one-product concentrate if desired.
Deister Machine Co., 1933-2003 E. Wayne St., Ft. Wayne, Ind., U. S. A. No. 1, London Wall Bldgs., London Wall, E. C.
Prices on application.
Single- or double-deck Deister "Simplex" sand concentrators, standard size; single- or double-deck Deister "Simplex" slime concentrators; single- or double-deck Deister "Simplex" sand concentrators, large size; Deister multiple-deck tilting slimers, 6- or 12-deck type; Deister cone baffle classifier; Deister patented plateau and riffling system for all types of shaking tables. Double-deck tables save mill room, launders, conveyors and power. Deister simplex rougher has large capacity for roughing and at the same time produces a clean concentrate, all in one operation.
Agents: William L. Reeder, 410 Consolidated Building, Johannesburg, South Africa; Takata & Co., 2 Yeiraku-cho, Nichome, Kojimachi-ku, Tokyo, Japan.
Denver Engineering Works Co., Denver, Colo.
"Isbell" takes unclassified feed.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
Card concentrators.
Isbell Concentrator Co., 716 North Main St., Los Angeles, Calif.
Capacity: Fifty to 100 tons per 24 hours. Isbell concentrator takes feed direct from 6-mesh and finer screens without classification and saves slime and fine values along with coarse. Parts of head motion and universal sliding bearings work in oil.
James Ore Concentrator Co., Newark, N. J.
Mine & Smelter Supply Co., The, Denver, Colo.
Branches: Salt Lake City, El Paso, New York.
Sole manufacturers of "Wilfley" concentrating tables, single and double deck.
Morse Bros. Mach. & Supply Co., Denver, Colo.
Senn Concentrator Co., 611 First Nat. Bank Bldg., San Francisco, Calif., Senn Panning Motion. One size; 6 ft. x 6 ft. 9 in.; cap., 30 tons of —65 mesh, 75 tons of —20 mesh, 150 tons of —6 mesh per 24 hr.; feed water 360 to 500 gal. per ton ore; dressing water, 100 gal. per ton —65 mesh. Reqs. ½ hp.; shipping weight, 3,500 lbs.
Continuous panning motion keeps heavy pulp bed loose and settles metal particles through loose barren gangue without regard to size of particles. Moving belt withdraws concentrates from under waste which gradually moves down into tails. Can handle large tonnage and make sand, about 200 gal. per ton dry ore; reqs. ½ exceptionally high extraction with only enough water to keep pulp loose.
Traylor Engineering & Mfg. Co., Allentown, Penn.

Condensers
Alberger Pump & Condenser Co., New York City.
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Contractors, Diamond Drilling
Longyear Co, E. J., Minneapolis, Minn.
Sullivan Machinery Co., Chicago, Ill., U. S. A.
Modern outfits and skilled operators ready.

Converters, Electric Rotary
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Converters, Horizontal and Vertical
Traylor Eng. & Mfg. Co., Allentown, Penn.

Conveyors and Elevators
Jeffrey Mfg. Co., The, 974 N. 4th St., Columbus, O.

Conveyors, Belt
Morse Bros. Mach. & Supply Co., Denver, Colo.
Robins Conveying Belt Co., New York
Stephens-Adamson Mfg. Co., Aurora, Ill.
"Unit Carrier" operates for long time on grease originally packed in bearings at factory and requires minimum of attention. Entire steel construction combines strength and light weight with great flexibility and range of adjustment. See advertisement on inside front cover for branch office addresses.
Traylor Engineering & Mfg. Co., Allentown, Penn.

Coolers, Air
Laidlaw Works, 115 Broadway, New York.

Copper Steel Sheets
American Sheet & Tin Plate Co., Pittsburgh, Pa.

Couplings, Air Hose
Cleveland Rock Drill Co., Cleveland, Ohio.
Twelve sizes and types. "Neverleak." All sizes interchangeable. Made to resist rust and acid. No threads.
Hardsocg Wonder Drill Co., Ottumwa, Iowa.
½", ¾" and 1" hose. No springs or threads.

Cranes, Locomotive
Industrial Works, Bay City, Mich.
Five to 160 tons cap. Steam, electric, gasoline.

Crucibles, Graphite
Dixon Crucible Co., Joseph, Jersey City, N. J.

Crusher Parts
Traylor Engineering & Mfg. Co., Allentown, Pa.

Crushers
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Bacon, Earle C., Havemeyer Bldg., New York.
Braun Corporation, The, Los Angeles, Calif.
Laboratory steel frame jaw crushers.
Braun-Knecht-Heimann Co., San Francisco, Cal.
Buchanan Co., Inc., C. G., New York.
Colorado Iron Works Co., Denver, Colo.
Jaw crushers and rolls in many sizes.
Denver Engineering Works Co., Denver, Colo.
Denver Fire Clay Co., Denver, Colo., U. S. A.
Jaw type.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
Jeffrey Mfg. Co., The, 974 N. 4th St., Columbus, O.
Kent Mill Co., 10 Rapelyea St., Brooklyn, N. Y.
Revolving concave ring. Rolls track inside.
Kenyon, Arthur D., Denver, Colo.
Mine & Smelter Supply Co., The, Denver, Colo.
Branches: Salt Lake City, El Paso, New York.
Morse Bros. Mach. & Supply Co., Denver, Colo.
Smith Eng. Wks., 3195 Locust St., Milwaukee, Wis.
"Telsmith" primary breakers. Rigid shaft type with short frame and parallel stroke. Gyratory.
Traylor Engineering & Mfg. Co., Allentown, Penn.
Gyratory crushers in sizes from 2 to 10 inclusive; jaw crushers, Blake type from 7"x10" up to 66"x86"; crushing rolls in all standard sizes from 18"x10" up to 72"x36".
Universal Road Machinery Co., Kingston, N. Y.
Webb City & Carterville Foundry & Machine Works, Webb City, Mo.
Roll type, designed for ready accessibility.

Cups, Grease (See "Grease Cups")

Cutting Apparatus
Davis-Bournonville Co.
See "Oxyacetylene Apparatus."

Cyanide
Roessler & Hasslacher Chemical Co., New York.

Diamonds, Black (See "Carbons and Bortz")

Doors, Automatic Mine
(See Mine Doors, Automatic)

Dredges
Flory Mfg. Co., S., Bangor, Penn.
Morris Machine Works, Baldwinville, N. Y.
New York Eng. Co., 2 Rector St., New York.
Union Construction Co., San Francisco, Calif.
Yuba Manufacturing Co., The, San Francisco, Calif.

Drilling, Core
Pennsylvania Drilling Co., Pittsburgh, Penn.
Sullivan Machinery Co., Chicago, Ill., U. S. A.

Drills, Churn
Union Construction Co., San Francisco, Calif.

Drills, Core
Ingersoll-Rand Co., 11 Broadway, New York.
Calyx—cores 1½ to 18⅝". Depths to 4,000 ft.
Sullivan Machinery Co., Chicago, Ill., U. S. A.

Drills, Diamond
Longyear Co., E. J., Minneapolis, Minn.
Sullivan Machinery Co., Chicago, Ill., U. S. A.
Cores removed of any size to any depth.

Drills, Electric
Denver Rock Drill Mfg. Co., Denver, Colo.
Ingersoll-Rand Co., 11 Broadway, New York.

Drills, Hammer
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Rock Drill Co., Cleveland, Ohio.
Four sizes hand- and self-rotating sinkers, 35 to 75 lb. weight.
New valve on stopers designed to give high efficiency, speed and low repairs. Drills for stoping, sinking, drifting, block-holing and every mining requirement.
Denver Rock Drill Mfg. Co., Denver, Colo.
"Dreadnaught"—self rotating, valveless, hammer drill, with water device; for drifting, tunneling and all heavy drilling. Can be used unmounted with spring handle for sinking, with water device or blow valve. "Clipper"—self rotating, valveless, hammer drill, with water device or blow valve, mounted or unmounted, for drifting, sinking, etc. "Waugh" Stoping; Valveless or valve; hammer drills; for stoping or upraising; equipped for either high or low pressure.
Hardsocg Wonder Drill Co., Ottumwa, Iowa.
All sizes and weights to 145 lb.
Have combination piston, valve and hammer. For stoping, sinking and all mining purposes.
Ingersoll-Rand Co., 11 Broadway, New York.
"Jackhamers," self-rotating hand hammer drills for every mining operation. Unmounted for down holes, mounted for light drifting, also with Leyner water device. "Leyner-Ingersoll" water drills for drifting, mining, tunneling. "Butterfly" type. "Stopehamers" "BC" and "CC" for raising, stoping, etc.
McKiernan-Terry Drill Co., 230 Bway., New York.
Sullivan Machinery Co., Chicago, Ill U. S. A.
Whitcomb Co., Geo. D., Rochelle, Ill.

Drills, Piston
Chicago Pneumatic Tool Co., Chicago, Ill.
Hardsocg Wonder Drill Co., Ottumwa, Iowa.
All sizes and weights.
For use with air or steam.
Ingersoll-Rand Co., 11 Broadway, New York.
"Butterfly," "Sergeant," "Electric Air." All sizes. Also heavy quarry and submarine types.
Sullivan Machinery Co., Chicago, Ill., U. S. A.

Drills, Prospecting
Ingersoll-Rand Co., 11 Broadway, New York.
New York Eng. Co., 2 Rector St., New York.
Rotation, sinking of casing, recovery of material accomplished at same time with "Empire."
Sullivan Machinery Co., Chicago, Ill., U. S. A.

Dryers, Ore
American Process Co., 68 William St., New York.
Especially designed and built for all materials.
Bartlett & Snow Co., The C. O., Cleveland, Ohio.
Morse Bros. Mach. & Supply Co., Denver, Colo.
Ruggles-Coles Eng. Co., York, Penn.
Traylor Engineering & Mfg. Co., Allentown, Penn.

Dust Hood
Multi-Metal Separating Screen Co., 253 W. 19th St., New York, N. Y.

Dust Protectors (See Respirators)

Dynamite
Aetna Explosives Co., 2 Rector St., New York.

Elbows, Pipe
National Tube Co., Pittsburgh, Penn.

Electrical Instruments
Weston Electrical Instrument Co., Newark, N. J.

Electrical Supplies
Mine & Smelter Supply Co., The, Denver, Colo.
Branches: Salt Lake City, El Paso, New York.

Elevators, Bucket
Robins Conveying Belt Co., New York.
Stephens-Adamson Mfg. Co., Aurora, Ill.
See advertisement on inside front cover for branch office addresses.
Traylor Engineering & Mfg. Co., Allentown, Penn.

Employees
Business Men's Clearing House, Denver, Colo.
Supts., assayers, mill men sent all parts of world.

Engines, Gas and Gasoline
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Chicago Pneumatic Tool Co., Chicago, Ill.
Morse Bros. Mach. & Supply Co., Denver, Colo.

Engines, Oil
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Chicago Pneumatic Tool Co., Chicago, Ill.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
Ingersoll-Rand Co., 11 Broadway, New York.
Morse Bros. Mach. & Supply Co., Denver, Colo.
Nordberg Mfg. Co., Milwaukee, Wis.

Engines, Steam
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Morse Bros. Mach. & Supply Co., Denver, Colo.

Exhausters
Connersville Blower Co., The, Connersville, Ind.
Morse Bros. Mach. & Supply Co., Denver, Colo.

Feeders, Ore
Stephens-Adamson Mfg. Co., Aurora, Ill.
"S-A" steel apron feeder; also rotary, reciprocating, grizzly, etc.
See inside cover for branch office addresses.
James Ore Concentrator Co., Newark, N. J.
Traylor Engineering & Mfg. Co., Allentown, Penn.

Filter Paper
Heil Chemical Co., Henry, St. Louis, Mo.

Filters
Colorado Iron Works Co., Denver, Colo.
"Portland" continuous revolving drum. For cyanide slimes, flotation concentrates, etc.
Oliver Continuous Filter Co., San Francisco, Cal.
Sizes 5 to 200 tons per day.
Automatic. For cyanide slimes, clay, salt, bicarbonate soda, and for dewatering flotation concentrate.
Traylor Engineering & Mfg. Co., Allentown, Penn.

Fire Forcing Presses
Wood & Co., R. D., Philadelphia, Penn.

Fittings, Pipe
National Tube Co., Pittsburgh, Penn.

Flange Presses
Wood & Co., R. D., Philadelphia, Penn.

Flanges, Pipe
National Tube Co., Pittsburgh, Penn.

Flexible Tubing
Bemis Bro. Bag Co., 400 Poplar St., St. Louis, Mo.
Sizes: 8-, 12- and 16-in. diameters; 100- and 200-ft. lengths.
"Flexoid" is a canvas tubing, flexible, portable and light. Furnished in various lengths and diameters, with simple, adjustable, metal connections. Air-tight and designed for use with fumes or acid waters. Adapts itself to irregula rflooring or can be suspended from roof.

Flotation Machines
Hardinge Conical Mill Co., 120 Broadway, N. Y.
Southwestern Eng. Co., Inc., 106 W. 3rd St., Los Angeles, Calif.

Flotation Oils
Flotation Oil & Chemical Co., 2 Rector St., N. Y.
General Naval Stores Co., 175 Front St., N. Y.
Pine oils, pine tar oils, turpentines, coal tar oils, wood creosotes, etc.
Georgia Pine Turpentine Co., 160 Perry St., New York City.
Pensacola Tar & Turpentine Co., Gulf Point, Fla.

Flotation, Oil
Minerals Separation North American Corporation, 61 Broadway, New York. Merchants' Exch. Bldg., San Francisco.
Separates sulphide minerals from gangue.
Oliver Continuous Filter Co., San Francisco, Cal.
Dewaterer and dryer of flotation concentrate.

Forges
Denver Fire Clay Co., Denver, Colo., U. S. A.
Oil-fired for drill steel. Send for catalog.

"On-the-Job" GANDY'S 10th Show-Down

A HARD-TO-BEAT MILL RECORD—

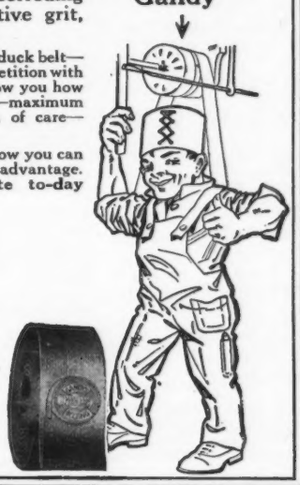
¶ "Twenty years hugging the main drive pulley—twenty years without a break-down—that's my record in a Maryland mill.

¶ "This isn't a just-by-chance happening—it's the kind of performance I'm giving in hundreds of industrial plants, textile mills, fertilizer works, lumber mills and machine shops where I'm subjected to live steam, corroding oils, acid fumes, destructive grit, or weather—cold and hot.

¶ "Put the original stitched cotton duck belt—"On-the-Job" GANDY—in competition with any other belt made and I'll show you how to get *all the pull from the pulley*—maximum transmission for the minimum of care—and at a third less cost."

¶ We will gladly advise you just how you can use GANDY BELTS to your advantage. There's no obligation—write to-day for particulars and prices.

"On-the-Job" Gandy



THE GANDY BELTING CO.

739 W. Pratt Street
Baltimore, Md.

New York Branch:
36 Warren Street

FJAB

HOLLOW
Rock Drill Steel

SOLID
Rock Drill Steel

Hexagon, Octagon, Quarter-Octagon, Round and Cruciform.

A. MILNE & COMPANY
(Established 1887)

745 Washington St., New York 8 Oliver St., Boston, Mass.

Chicago Branch: 550 Washington Boulevard, Chicago, Ill.

Sole and Direct Representatives for the United States and Canada.

Ball Bearing Belt Conveyors

Trump Measuring and Mixing Machines.

Merrick Conveying Weighers for Belt Conveyors

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Wood & Co., R. D., Philadelphia, Penn.

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Wellman-Seaver-Morgan Co., The, Cleveland, O.
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Grease Cups
Lunkenheimer Co., The, Cincinnati, Ohio.

Grinders, Ore
Braun Corporation, The, Los Angeles, Calif.
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Laboratory machines for ore, coke and coal.
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Simmons Co., John, 34 35th St., Brooklyn, N. Y.
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Traylor Engineering & Mfg. Co., Allentown, Pa.

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American Locomotive Co., 30 Church St., N. Y.

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American Locomotive Co., 30 Church St., N. Y.

Locomotive Parts
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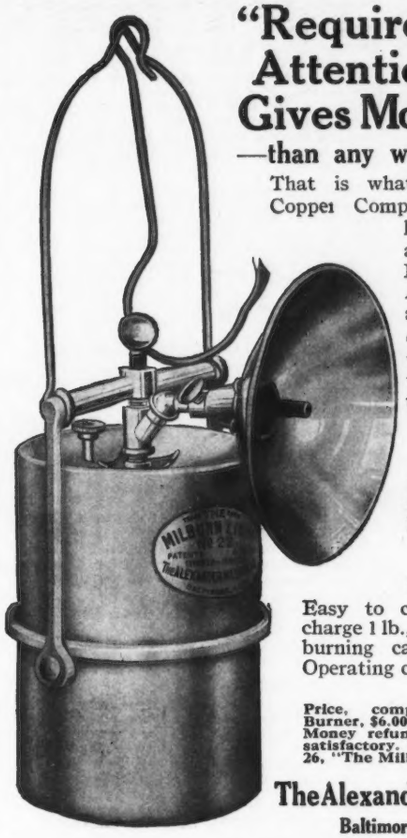

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American Zinc, Lead & Smelting Co., 55 Congress St., Boston, Mass.
American Zinc & Chemical Co., Langeloth, Penn.
Arizona Copper Co., Clifton, Ariz.
Arkansas Zinc & Smelting Corp., 42 Broadway, New York.
Balbach Smelting & Refining Co., Newark, N. J.
Bartlesville Zinc Co., 52 Broadway, New York.
Beer, Sondheimer & Co., 61 Broadway, New York. Branch: 1101 Newhouse Bldg., Salt Lake City, Utah.
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Foote Mineral Co., 107 N. 19th St., Phila., Pa.
Grasselli Chemical Co., The, Cleveland, Ohio.
Hardy, Charles, 50 Church St., New York.
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Illinois Zinc Co., Peru, Ill.
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Libby & Co., Inc., Scott L., 45 Broadway, N. Y.
Leavitt & Co., C. W., 30 Church St., New York.
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Nichols Copper Co., 25 Broad St., New York.
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Ozark Mining Co., 601 Canal Rd., Cleveland, Ohio.
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St. Joseph Lead Co., 61 Broadway, New York.
United Metals Selling Co., 42 Broadway, New York. European Agents: C. S. Henry & Co., Ltd., 12 Leadenhall St., London, E. C.; United Metals Selling Co., G. M. B. H., Unter den Linden 56, Berlin, Germany.
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High-grade welding apparatus $60, Canada $75. "Prest-O-Lite" process employs both acetylene and oxygen in portable cylinders. "Prest-O-Lite" dissolved acetylene provides dry, purified gas and avoids use of carbide generator.

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Laboratory machines for all purposes and prospecting.
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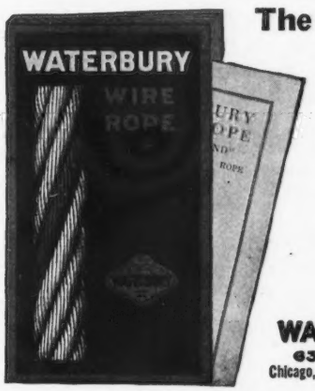

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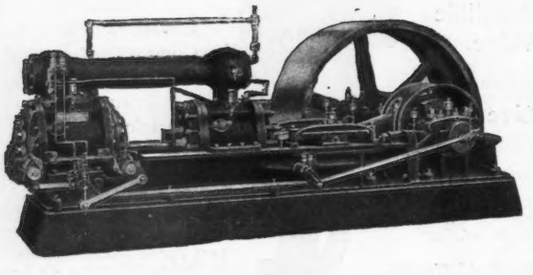

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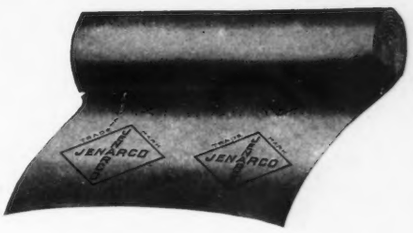

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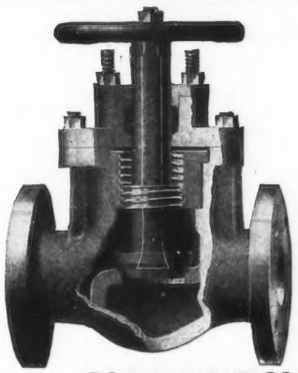

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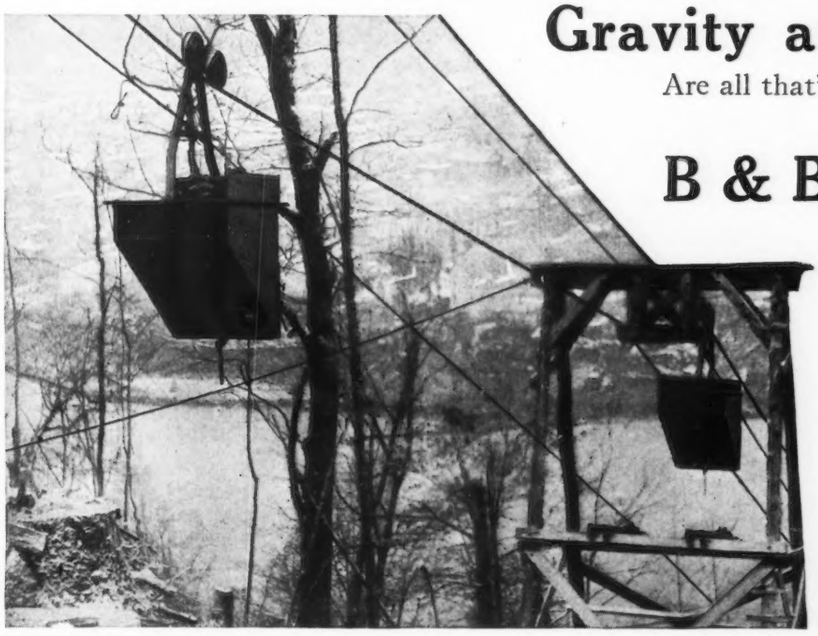

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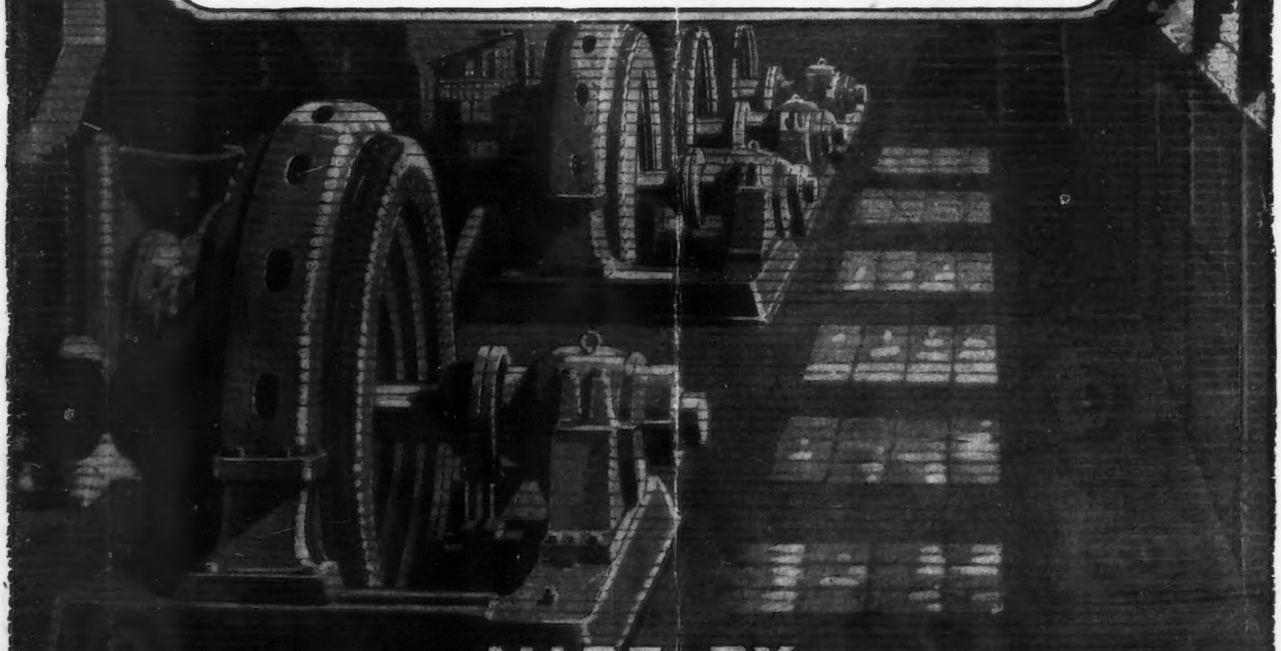

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